

# **Detailed Energy Audit**

## **The Town of Concord, Massachusetts**

### **Municipal Buildings**

#### **Final Report**

**August 21, 2009**



**Prepared by**



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## Section I - Executive Summary

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American Development Institute (ADI) has been retained by the Town of Concord, Massachusetts to prepare a detailed energy audit for nine of the Town's municipal buildings. The detailed energy audit was commissioned in order to identify cost-effective energy conservation measures (ECM's) that would be feasible for implementation in order to reduce the energy cost and environmental impact of the buildings.

Based on our investigations, ADI has developed construction cost, energy cost savings, and simple payback numbers for a total of five ECM's that apply to various buildings. ADI recommends the installation of efficient lighting fixtures and Energy Management Systems in most of the buildings surveyed. In addition, boiler replacements were evaluated for two buildings as were two ECM's relative to the swimming pool systems in the Beede Center.

ADI estimates that the implementation of all recommended ECM's will result in an annual energy cost savings of \$78,334 with an aggregate simple payback of 7.7 years based on a \$604,000 project cost. The projected annual energy savings represents a reduction in annual energy usage of 25% as compared to existing conditions for all buildings combined. ADI also projects a reduction in source CO2 emissions of just over 744,000 pounds per year based on the implementation of all recommended ECM's.

Annual energy savings (units saved and cost savings) are summarized in Table 1.1 below, along with our opinion of the probable construction cost for each project and the simple payback for each ECM to be implemented in each building.

Table 1.2 shows the economic summary for each of the five ECM's if implemented across all buildings. Table 1.3 shows the economics of the ECM's totaled for each individual building. Table 1.4 provides a projection of the annual energy use and energy costs for each building after implementation of all ECM's. Also shown is the reduction in energy intensity for each building and the overall CO2 reduction based on the electric and gas units saved annually.

As will be discussed in this report, the proposed implementation of the *Smart Grid* control system by the Concord Municipal Light Plant may be a lower capital cost alternative to ECM #2 – Energy Management System.

Incentives for some of the projects that save natural gas may be available from National Grid USA based on reductions in annual therms consumed. Since the incentive programs change from time to time, the incentives would have to be determined by National Grid representatives at the time of final design and contracting for the ECM installations.

## Town Of Concord Massachusetts

Table 1.1 - Executive Summary Of All Energy Conservation Measures (ECM's)

Building	ECM #	ECM Description	Energy Units Saved		Energy Unit Costs		Annual Energy Cost Savings	Opinion Of Probable Construction Cost	Simple Payback
			Electricity kWh	Natural Gas Therms	Electricity \$/kWh	Natural Gas \$/Therm			
Concord Town House	ECM-1	High-Efficiency Lighting Systems & Controls	4,309	0	\$0.085	\$1.48	\$ 366	\$ 3,119	8.5
	ECM-2	Energy Management System	21,748	1,081	\$0.085	\$1.48	\$ 3,453	\$ 70,800	20.5
<b>Concord Town House - Subtotals</b>			<b>26,056</b>	<b>1,081</b>	<b>---</b>	<b>---</b>	<b>\$ 3,819</b>	<b>\$ 73,919</b>	<b>19.4</b>
Harvey Wheeler Center	ECM-1	High-Efficiency Lighting Systems & Controls	2,827	0	\$0.085	\$1.34	\$ 240	\$ 1,800	7.5
	ECM-2	Energy Management System	14,867	3,667	\$0.085	\$1.34	\$ 6,165	\$ 24,000	3.9
<b>Harvey Wheeler Center - Subtotals</b>			<b>17,694</b>	<b>3,667</b>	<b>---</b>	<b>---</b>	<b>\$ 6,406</b>	<b>\$ 25,800</b>	<b>4.0</b>
Public Works 133 Keyes Road	ECM-1	High-Efficiency Lighting Systems & Controls	10,189	0	\$0.085	\$1.34	\$ 866	\$ 8,807	10.2
	ECM-2	Energy Management System	2,910	2,497	\$0.085	\$1.34	\$ 3,594	\$ 40,200	11.2
<b>Public Works - Subtotals</b>			<b>13,099</b>	<b>2,497</b>	<b>---</b>	<b>---</b>	<b>\$ 4,460</b>	<b>\$ 49,007</b>	<b>11.0</b>
Water/Sewer 135 Keyes Road	ECM-1	High-Efficiency Lighting Systems & Controls	7,486	0	\$0.085	\$1.45	\$ 636	\$ 6,614	10.4
	ECM-2	Energy Management System	1,022	1,462	\$0.085	\$1.45	\$ 2,202	\$ 21,800	9.9
<b>Water/Sewer - Subtotals</b>			<b>8,508</b>	<b>1,462</b>	<b>---</b>	<b>---</b>	<b>\$ 2,838</b>	<b>\$ 28,414</b>	<b>10.0</b>
Planning Department 141 Keyes Road	ECM-1	High-Efficiency Lighting Systems & Controls	1,346	0	\$0.085	\$1.44	\$ 114	\$ 1,455	12.7
	ECM-2	Energy Management System	4,104	1,037	\$0.085	\$1.44	\$ 1,841	\$ 32,400	17.6
<b>Planning Department - Subtotals</b>			<b>5,449</b>	<b>1,037</b>	<b>---</b>	<b>---</b>	<b>\$ 1,955</b>	<b>\$ 33,855</b>	<b>17.3</b>
Police & Fire Station	ECM-1	High-Efficiency Lighting Systems & Controls	18,652	0	\$0.085	\$1.36	\$ 1,585	\$ 7,597	4.8
	ECM-2	Energy Management System	13,360	3,339	\$0.085	\$1.36	\$ 5,685	\$ 63,400	11.2
	ECM-3	Boiler Replacement	0	2,614	\$0.085	\$1.36	\$ 3,561	\$ 48,415	13.6
<b>Police &amp; Fire Station - Subtotals</b>			<b>32,012</b>	<b>5,953</b>	<b>---</b>	<b>---</b>	<b>\$ 10,832</b>	<b>\$ 119,412</b>	<b>11.0</b>
West Concord Fire Station	ECM-1	High-Efficiency Lighting Systems & Controls	2,275	0	\$0.085	\$1.37	\$ 193	\$ 1,607	8.3
	ECM-2	Energy Management System	0	1,341	\$0.085	\$1.37	\$ 1,835	\$ 21,600	11.8
	ECM-3	Boiler Replacement	0	1,548	\$0.085	\$1.37	\$ 2,117	\$ 32,085	15.2
<b>West Concord Fire Station - Subtotals</b>			<b>2,275</b>	<b>2,889</b>	<b>---</b>	<b>---</b>	<b>\$ 4,145</b>	<b>\$ 55,292</b>	<b>13.3</b>
Beede Center	ECM-1	High-Efficiency Lighting Systems & Controls	26,400	0	\$0.085	\$1.24	\$ 2,244	\$ 9,182	4.1
	ECM-2	Energy Management System	23,082	2,523	\$0.085	\$1.24	\$ 5,099	\$ 29,000	5.7
	ECM-4	Pool Pumps - Variable Frequency Drives	192,395	0	\$0.085	\$1.24	\$ 16,354	\$ 30,070	1.8
	ECM-5	Automatic Swimming Pool Covers	61,505	8,896	\$0.085	\$1.24	\$ 16,291	\$ 110,346	6.8
<b>Beede Center - Subtotals</b>			<b>303,382</b>	<b>11,419</b>	<b>---</b>	<b>---</b>	<b>\$ 39,988</b>	<b>\$ 178,598</b>	<b>4.5</b>
Hunt Recreation Facility	ECM-1	High-Efficiency Lighting Systems & Controls	2,538	0	\$0.085	\$1.36	\$ 216	\$ 961	4.5
	ECM-2	Energy Management System	8,849	2,143	\$0.085	\$1.36	\$ 3,675	\$ 38,800	10.6
<b>Hunt Recreation Facility - Subtotals</b>			<b>11,386</b>	<b>2,143</b>	<b>---</b>	<b>---</b>	<b>\$ 3,891</b>	<b>\$ 39,761</b>	<b>10.2</b>

**Town Of Concord Massachusetts**  
**Summary Tables Of Energy Conservation Measures**

**Table 1.2 - Economic Summary By ECM**

ECM #	ECM Description	Energy Units Saved		Annual Energy Cost Savings	Opinion Of Probable Construction Cost	All Buildings Simple Payback
		Electricity kWh	Natural Gas Therms			
ECM-1	High-Efficiency Lighting Systems & Controls	76,021	0	\$ 6,462	\$ 41,143	6.4
ECM-2	Energy Management System	89,941	19,090	\$ 33,550	\$ 342,000	10.2
ECM-3	Boiler Replacement	0	4,161	\$ 5,678	\$ 80,500	14.2
ECM-4	Pool Pumps - Variable Frequency Drives	192,395	0	\$ 16,354	\$ 30,070	1.8
ECM-5	Automatic Swimming Pool Covers	61,505	8,896	\$ 16,291	\$ 110,346	6.8
<b>Totals</b>		<b>419,862</b>	<b>32,147</b>	<b>\$ 78,334</b>	<b>\$ 604,059</b>	<b>7.7</b>

**Table 1.3 - Economic Summary By Building**

Building	Energy Units Saved		Annual Energy Cost Savings	Opinion Of Probable Construction Cost	All ECM's Simple Payback
	Electricity kWh	Natural Gas Therms			
Concord Town House	26,056	1,081	\$ 3,819	\$ 73,919	19.4
Harvey Wheeler Center	17,694	3,667	\$ 6,406	\$ 25,800	4.0
Public Works - 133 Keyes Road	13,099	2,497	\$ 4,460	\$ 49,007	11.0
Water/Sewer - 135 Keyes Road	8,508	1,462	\$ 2,838	\$ 28,414	10.0
Planning - 141 Keyes Road	5,449	1,037	\$ 1,955	\$ 33,855	17.3
Police & Fire Station	32,012	5,953	\$ 10,832	\$ 119,412	11.0
West Concord Fire Station	2,275	2,889	\$ 4,145	\$ 55,292	13.3
Beede Center	303,382	11,419	\$ 39,988	\$ 178,598	4.5
Hunt Recreation Facility	11,386	2,143	\$ 3,891	\$ 39,761	10.2
<b>Totals</b>	<b>419,862</b>	<b>32,147</b>	<b>\$ 78,334</b>	<b>\$ 604,059</b>	<b>7.7</b>

## Town Of Concord Massachusetts

Table 1.4 - Projected Annual Energy Use And Cost - After Installation Of Energy Conservation Measures

Building	Floor Area Square Feet	Electric Consumption Annual kWh	Natural Gas Consumption Annual Therms	Annual Energy Index (AEI) Btu's Per Square Foot Per Year			Annual Energy Costs			Annual Energy Cost Per Sq. Ft.
				Electricity	Fuel	Total	Electricity	Fuel	Total	
Concord Town House	14,838	81,984	5,021	18,858	33,838	52,696	\$ 6,969	\$ 7,456	\$ 14,425	\$0.97
Harvey Wheeler Center	18,000	95,987	9,454	18,200	52,521	70,721	\$ 8,159	\$ 12,636	\$ 20,795	\$1.16
Public Works - 133 Keyes Road	18,268	146,853	8,298	27,437	45,426	72,862	\$ 12,483	\$ 11,125	\$ 23,608	\$1.29
Water/Sewer - 135 Keyes Road	9,700	98,844	1,000	34,779	10,313	45,092	\$ 8,402	\$ 1,447	\$ 9,849	\$1.02
Planning - 141 Keyes Road	9,841	92,696	3,084	32,148	31,341	63,489	\$ 7,879	\$ 4,437	\$ 12,316	\$1.25
Police & Fire Station	14,431	268,796	8,107	63,572	56,177	119,749	\$ 22,848	\$ 11,045	\$ 33,893	\$2.35
West Concord Fire Station	5,204	37,066	5,084	24,310	97,692	122,002	\$ 3,151	\$ 6,954	\$ 10,104	\$1.94
Beede Center	34,000	922,447	31,901	92,597	93,827	186,424	\$ 78,408	\$ 39,672	\$ 118,080	\$3.47
Hunt Recreation Facility	12,492	83,856	5,670	22,911	45,389	68,300	\$ 7,128	\$ 7,733	\$ 14,861	\$1.19
<b>Totals</b>	<b>136,774</b>	<b>1,828,529</b>	<b>77,620</b>	<b>45,628</b>	<b>56,750</b>	<b>102,379</b>	<b>\$ 155,425</b>	<b>\$ 102,506</b>	<b>\$ 257,931</b>	<b>\$1.89</b>

Building	Floor Area Square Feet	AEI Btu/SF/Year	AEI Btu/SF/Year	AEI Percent Reduction
		Existing	After ECM Installations	
Concord Town House	14,838	65,972	52,696	20%
Harvey Wheeler Center	18,000	94,450	70,721	25%
Public Works - 133 Keyes Road	18,268	88,976	72,862	18%
Water/Sewer - 135 Keyes Road	9,700	63,158	45,092	29%
Planning - 141 Keyes Road	9,841	75,917	63,489	16%
Police & Fire Station	14,431	168,571	119,749	29%
West Concord Fire Station	5,204	179,009	122,002	32%
Beede Center	34,000	250,463	186,424	26%
Hunt Recreation Facility	12,492	88,566	68,300	23%
<b>Totals</b>	<b>136,774</b>	<b>136,360</b>	<b>102,379</b>	<b>25%</b>

CO2 Reductions From Energy Conservation		Source
Electricity - Pounds CO2 Reduced - Per kWh Saved: 0.876		NEPOOL
Natural Gas - Pounds CO2 Reduced - Per Therm Saved: 11.71		EIA

Town Of Concord Projected Annual CO2 Reductions Based On Implementation Of All ECM's	
Projected Annual kWh Saved	419,862
Factor	0.876
Electricity - Annual Pounds CO2 Reduction	367,799
Projected Annual Therms Saved	32,147
Factor	11.71
Natural Gas - Annual Pounds CO2 Reduction	376,445
<b>Total Annual Pounds CO2 Reduction</b>	<b>744,244</b>



## Section II - Description of Existing Buildings and Energy Systems

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### *Concord Town House – Description of Building and Energy Systems*



The Concord Town House is an older, historic building (original construction dates to 1851) of brick and masonry construction that comprises 14,838 square feet of floor area. The building houses administrative offices and two meeting rooms on two levels, and there is also a basement and an attic. The basement is used primarily for storage along with space allocated for the boiler room and the pumps for the HVAC system. The attic houses HVAC equipment and is also used for storage. The building is typically occupied from 8 AM to 5 PM weekdays with significant evening occupancy for meetings and occasional weekend occupancy.



**Heating Boiler System**



The Town House building was partially renovated in 2001 and the HVAC systems and some of the lighting fixtures were replaced at that time. The building has a central heating and cooling loop (two-pipe) with a gas-fired Hydrotherm modular boiler located in the basement along with two 2 HP hot water pumps and two 5 HP chilled water pumps (one operational and one serving as a “back-up” in each case). Cooling is provided by a packaged air-cooled water chiller, which is located outdoors next to the adjacent Monument Square office building.



**Air-Cooled Chiller**

Seasonal changeover of the system from the boiler (heating) to the chiller (cooling) is done manually. The HVAC terminal equipment consists of individual fan coil units that provide temperature control to offices and other spaces, along with three air handling units that are configured to provide 100% fresh air for ventilation. There is an exhaust fan for general building exhaust located above the ceiling in the rear office and lunch room area.



**Hot Water And Chilled Water Pumps**

The basement is heated only (not air conditioned), with the exception of a small server closet that has a fan coil unit. The basement area is served by six unit heaters. The basement heaters are left “off” due to the fact that supplemental heating is not required. The first level of the building is served by a total of 17 fan coil units, with cabinet unit heaters (2) providing space heat to toilet rooms. The second level also has 17 fan coil units (though the units are of different capacities) and two cabinet unit heaters. One of the 100% fresh air handling units (AHU-1) is located in the basement while AHU-2 and AHU-3 are located in the attic.



**Air Handling Unit**

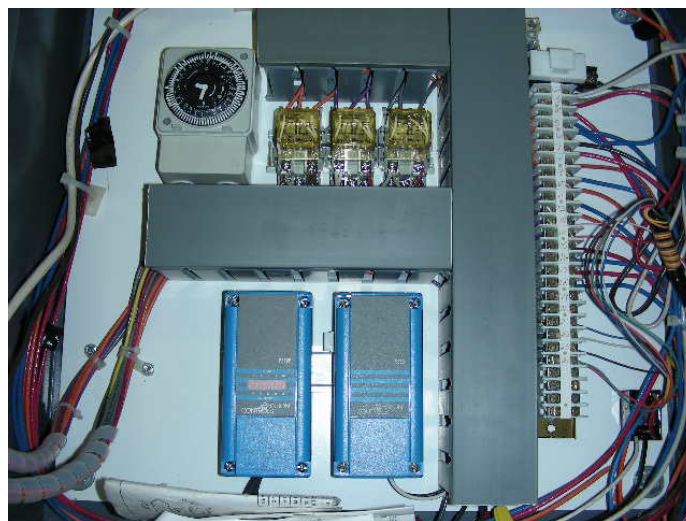
Each air handling unit is configured to introduce 100% outside air, with a hot water coil and a chilled water coil supplied by the central two-pipe system. Several of the bathrooms have portable electric heaters in use; staff indicated that these are unplugged at night. Two central exhaust fans provide bathroom and general exhaust.



**Temperature Control Panel**



**Carrier Control Panel**



**Air Handling Unit Control Panel**



The temperature control system consists of conventional electronic controls with a Carrier control panel observed in the basement mechanical room. There was no specific documentation available on the Carrier control system. The Carrier control panel that is located in the basement appears to be a duplicate of the operating panel that is mounted on the outdoor chiller. While the outdoor chiller control panel is fully operational, the remote panel in the basement is not operational. Based on discussions with building staff, the outdoor panel is used to operate and schedule the chiller operation. While the indoor panel would be a convenience it is believed that its functions are duplicated by the outdoor panel. The air handling units have control panels that incorporate Johnson Controls electronic stand-alone controls.

Each individual fan coil unit has factory packaged controls for fan speed and temperature. ADI observed during the walkthrough (cold day) that some spaces were overheating. In particular, the Hearing Room was quite warm with all fan coil units in operation despite the fact that the room was not in use. ADI also observed that none of the three air handling units was in operation at the time of the walkthrough. Staff indicated that the three air handling units are not generally used; however one is occasionally operated to provide supplemental cooling during hot weather.



**Fan Coil Unit Controls**

### ***Other Systems and General Observations***

Lighting systems in the building include a mixture of older fixture types and new efficient lighting fixtures. There are some existing older T12 lamps and ballasts, some incandescent bulbs, and exterior 300W quartz (incandescent) fixtures. Some enclosed offices do not have occupancy sensors in place for lighting control.

A 40 gallon gas-fired tank located in the basement provides domestic hot water for the building. Plumbing fixtures in the building are all new and are configured for low water use. A single soda vending machine (no panel lights) was observed in the rear entryway.



**Gas-Fired Domestic Hot Water Tank**

The building envelope appears to be in good condition with some noted exceptions. The attic space as originally constructed was adequately insulated. However; the attic floor insulation in the front section has been disturbed over the years and in some areas it is unevenly distributed. Due to the presence of the plywood floor in the attic space, the exact condition of the insulation in most of the attic space cannot be determined based on simple visual inspection. In the front section of attic space, there is no barrier between the untreated attic air and the open walls leading from the attic to the occupied space.

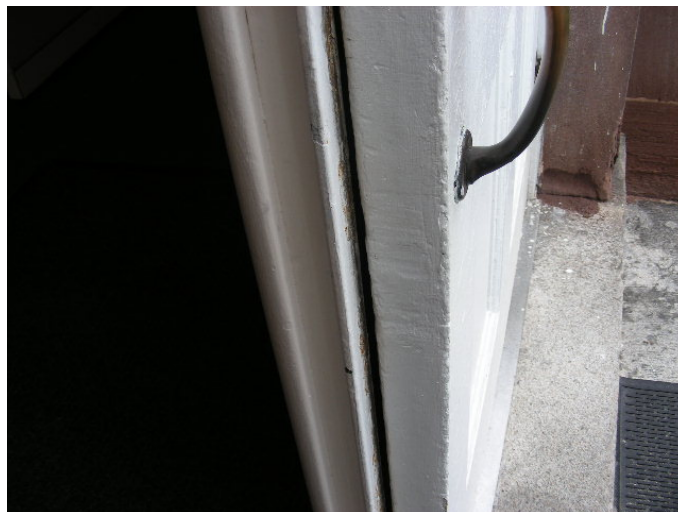
The exterior windows are original, uninsulated, single-pane windows and frames to accommodate the historic nature of the building with new exterior storm windows recently installed.



**Attic Insulation – Partially Disturbed**



**Window With Exterior Storm Window**



**Exterior Door**

### *Existing Annual Energy Use*

The Concord Town House utilizes electricity purchased from CMLP and natural gas purchased from National Grid. The table below summarizes the recent annual energy use for the building and provides the annual energy usage and costs broken down per square foot of floor area. The Town House was having new storm windows installed at the time of the energy audit. The energy usage shown in this table predate the installation of the storm windows. ADI believes that the storm window installation will reduce the annual energy usage (particularly the fuel usage for space heating) to a level somewhat lower than indicated by the existing energy usage data.

<b>Annual Energy Use And Cost Summary</b>		
<b>Concord Town House</b>		<b>Square Footage: 14,838</b>
<b>Energy Consumption And Cost Data</b>	Electric Consumption - Annual kWh	108,040
	Total Annual Electric Cost	\$ 16,442
	Natural Gas Consumption - Annual Therms	6,875
	Total Annual Fuel Cost - Natural Gas	\$ 10,209
	<b>Total Annual Energy Cost</b>	<b>\$ 26,651</b>
<b>Unit Costs For Energy</b>	Electricity - Average Cost Per kWh	\$0.152
	Natural Gas - Average Cost Per Therm	\$1.485
	Electricity - Consumption Cost Per kWh	\$0.085
<b>Annual Energy Use And Cost Breakdown</b>	Electricity - kWh Per Square Foot Per Year	7.3
	Electricity - Btu Per Square Foot Per Year	24,851
	Electric Cost Per Square Foot Per Year	\$ 1.11
	Fuel - Btu Per Square Foot Per Year	46,334
	Fuel Cost Per Square Foot Per Year	\$ 0.69
<b>Annual Energy Index (AEI)</b>	Total AEI - Btu Per Square Foot Per Year	71,185
	Total Energy Cost Per Square Foot Per Year	\$ 1.80

The annual energy use factors for the building will be further discussed in the following section of this report.



***Harvey Wheeler Community Center – Description of Building and Energy Systems***



The Harvey Wheeler Community Center is a single story building with a partially finished basement. The building comprises 18,000 square feet of floor area and is of block construction with a concrete and stone exterior. The building was constructed circa 1916 and a complete renovation was done in 2004 with all new interior finishes, new windows, and new HVAC and lighting systems. The building includes classrooms, meeting rooms, and offices. Typical usage hours are from about 8 AM to 6 PM weekdays for the primary building space; there is also significant usage of some spaces during evenings and weekends. The building has a commercial-type kitchen that is used only for special events.



**Lochinvar Hot Water Boiler**

The Wheeler Center building has a central space heating loop with a Lochinvar high-efficiency gas-fired boiler and two 1 ½ HP hot water circulating pumps. The forced hot water supply is utilized by baseboard fintube convectors, which provide the primary building heat. There are also a number of cabinet unit heaters serving vestibules and some propeller-type unit heaters serving utility areas and the unfinished basement.



**Hot Water Pumps**

Air conditioning and ventilation systems consist of a total of seven air handling units that are located in the attic space. Each air handling unit is set up for single-zone operation with a supply fan, outside and return air dampers, and a two-stage direct expansion (DX) cooling coil. Each of the seven air handlers has an associated air-cooled condensing unit located on the roof of the building. The air handling units do not incorporate heating coils; the baseboard fin-tube systems and unit heaters provide all space heating. The air handling units are each of relatively small size/capacity (3 tons to 7 ½ tons) with small horsepower supply air fans (¾ HP to 1 ½ HP). There is another small split DX system in place to serve the elevator machine room.



**Air Handling Unit**

The air handling units serve the various areas as follows:

Unit	Area Served
AHU-1	Classrooms 1 & 2
AHU-2	Classroom 3 & Day Care
AHU-3	Teacher's Room, Meeting Room, Kitchen
AHU-4	Conference Room, Wellness Area
AHU-5	Offices, Thrift Shop, Conference Room, Storage
AHU-6	Auditorium
AHU-7	Basement – Music, Recreation, Lecture, Library, Studio

Fresh air for ventilation is introduced to each of the seven air handling units by a separate makeup air unit (MUA-1) located on the roof. This unit is configured to bring in 100% outside air and includes a DX cooling coil and a gas-fired heating coil. This makeup air unit draws in fresh air and tempers the air by either heating or cooling it. The tempered fresh air is then ducted to the mixing section of each air handling unit.



**Honeywell EMS Panel**

For temperature control, the building has a Honeywell Energy Management System (EMS) in place that provides Direct Digital Control (DDC) of all HVAC equipment. The Honeywell EMS was installed at the time of the building renovation. The EMS provides control of the air handling units, the makeup air unit, the boiler and pumps, some unit heaters, and some fintube radiation zones. Other unit heaters and fintube zones have integral self-contained controls. The EMS includes local space temperature sensors which incorporate setpoint adjustment and override features.



**Space Temperature Sensor**

### ***Other Systems and General Observations***

Lighting systems in the building are new and are very efficient, with T8 and compact fluorescent lamps in place along with occupancy sensors as appropriate. Two problems with the existing lighting were noted. There is a “security” circuit for some of the hallway lighting that is on continuously 24 hours per day, though security lighting is not needed per building staff (there is a separate emergency lighting system for egress). The second issue is that there is no occupancy sensing control in the auditorium, and these lights are



on for a number of hours per day when the space is unoccupied. ADI noted that there is a Quanta Elite lighting control panel in a closet that controls the lights in the auditorium.



**Occupancy Sensors For Lighting Control**



**Lighting Control Panel - Auditorium**

A PVI high-efficiency gas-fired tank located in the boiler room provides domestic hot water for the building. Plumbing fixtures in the building are all new and are configured for low water use.



**Gas-Fired Domestic Hot Water Tank**

The building envelope appears to be in excellent condition. The attic space was observed to be adequately insulated. The exterior windows were replaced as part of the 2004 renovation and are new thermal-pane windows.

### ***Existing Annual Energy Use***

The Harvey Wheeler Center utilizes electricity purchased from CMLP and natural gas purchased from National Grid. The table below summarizes the recent annual energy use for the building and provides the annual energy usage and costs broken down per square foot of floor area.

<b>Annual Energy Use And Cost Summary</b>		
<b>Harvey Wheeler Center</b>		<b>Square Footage: 18,000</b>
<b>Energy Consumption And Cost Data</b>	Electric Consumption - Annual kWh	113,681
	Total Annual Electric Cost	\$ 16,206
	Natural Gas Consumption - Annual Therms	13,121
	Total Annual Fuel Cost - Natural Gas	\$ 17,538
	<b>Total Annual Energy Cost</b>	<b>\$ 33,744</b>
<b>Unit Costs For Energy</b>	Electricity - Average Cost Per kWh	\$0.143
	Natural Gas - Average Cost Per Therm	\$1.337
	Electricity - Consumption Cost Per kWh	\$0.085
<b>Annual Energy Use And Cost Breakdown</b>	Electricity - kWh Per Square Foot Per Year	6.3
	Electricity - Btu Per Square Foot Per Year	21,555
	Electric Cost Per Square Foot Per Year	\$ 0.90
	Fuel - Btu Per Square Foot Per Year	72,894
	Fuel Cost Per Square Foot Per Year	\$ 0.97
<b>Annual Energy Index (AEI)</b>	Total AEI - Btu Per Square Foot Per Year	94,450
	Total Energy Cost Per Square Foot Per Year	\$ 1.87

The annual energy use factors for the building will be further discussed in the following section of this report.



### ***Public Works Offices/Garage – Description of Building and Energy Systems***



The Concord Public Works building at 133 Keyes Road comprises 18,268 square feet and includes an office section and a number of garage bays. Typical usage is from 7:00 AM to 5:00 PM weekdays, with occasional evening and weekend usage during emergencies. The building is of block construction with a brick exterior facade on the office building section. Original construction was circa 1940's; however the spaces were renovated and improved in the late 1990's when the building was acquired by the Concord Public Works Department from the Concord Municipal Lighting Plant.

#### ***HVAC Systems – Office Area***

The office wing is heated via a hydronic baseboard loop supplied by a small Weil/McLain hot water boiler. The boiler is less than ten years old and is gas-fired. The hydronic loop includes two small zone pumps and a pressure-controlled bypass loop. There is a separate small zone pump that supplies forced hot water to the break room that is located adjacent to one of the bays.



**Office Wing Hot Water Boiler**



**Office Wing Hot Water Circulating Pumps**

The boiler room houses two air conditioning units (AC-1 and AC-2), each of which has an outdoor air-cooled condensing unit. Each of these AC units has a cooling capacity in the range of 5 tons to 7 ½ tons. The hydronic heating system has a number of zone valves, each controlled by an electric or electronic space thermostat. Each of the AC units has a simple space thermostat for control. Staff noted some air balancing issues with the air conditioning systems.



**Boiler Controller**

***Heating & Ventilation Systems – Truck and Equipment Bays***

The bays are heated and ventilated with a combination of gas-fired unit heaters, exhaust fans, and makeup air units. In addition, a waste oil fired forced-air furnace is in place in the first section (Bays 1-3). The following heating and ventilation equipment is in place (per the 1998 renovation plans):

<b>Bays</b>	<b>Heating &amp; Ventilating Equipment</b>
Bays 1-3	Makeup Air Unit MAU-1
	Gas-Fired Unit Heaters (2)
	Exhaust Fan EF-6 (1)
	Waste Oil Burning Furnace
Bays 4-6	Makeup Air Unit MAU-2
	Gas-Fired Unit Heaters (2)
	Exhaust Fan EF-7 (1)
Bays 7-11	Gas-Fired Unit Heaters (2)
	Exhaust Fans EF-4 (2)
Bay 12	Makeup Air Unit MAU-3
	Gas-Fired Unit Heater (1)
	Exhaust Fan EF-5 (1)
Bays 13-18	Gas-Fired Unit Heaters (2)
	Exhaust Fans EF-6 (2)
	Toilet Exhaust Fan EF-8 (1)
Bays 19-21	Makeup Air Unit MAU-1
	Gas-Fired Unit Heater (1)
	Exhaust Fan EF-6 (1)



**Gas-Fired Makeup Air Unit**

In addition to the above, the break room has hot water fin tube heat that is supplied by the office section boiler. One break room also has a small ductless split AC system. Other small rooms have supplemental heat via electric baseboard units. There is no system in place for scheduling and setback control of the heating and ventilating systems.



**Gas-Fired Unit Heater**

Conventional thermostats are used, in addition to manual on/off and summer/winter switches for the makeup air units. The makeup air units are used sporadically and are manually started and stopped as required. The second break room (at bays 19-21) and office area is served by a small split DX system with gas heat. This unit has a programmable electronic space thermostat.





**Thermostat And Exhaust Fan Controls**

### ***Other Systems and General Observations***

The existing lighting systems in the building consist primarily of newer high-efficiency T8 fixtures; however there are some older fixtures in place. Older fixtures include fluorescent fixtures with T12 four-foot and eight-foot lamps and some 400W metal halide fixtures (Garage 22).

In general the windows and doors in the building are newer and are in good condition. The rollup doors on the bays are a mix of newer doors and some older doors but all appear to be in good condition. One of the exist doors at the last bay was observed to have no weather stripping.

The break room has one soda machine and one snack machine; neither was observed to have panel lights.

### ***Existing Annual Energy Use***

The Concord Public Works building utilizes electricity purchased from CMLP and natural gas purchased from National Grid. The table below summarizes the recent annual energy use for the building and provides the annual energy usage and costs broken down per square foot of floor area.

<b>Annual Energy Use And Cost Summary</b>		
<b>Public Works - 133 Keyes Road</b>		<b>Square Footage: 18,268</b>
<b>Energy Consumption And Cost Data</b>	Electric Consumption - Annual kWh	159,952
	Total Annual Electric Cost	\$ 19,956
	Natural Gas Consumption - Annual Therms	10,795
	Total Annual Fuel Cost - Natural Gas	\$ 14,472
	<b>Total Annual Energy Cost</b>	<b>\$ 34,428</b>
<b>Unit Costs For Energy</b>	Electricity - Average Cost Per kWh	\$0.125
	Natural Gas - Average Cost Per Therm	\$1.341
	Electricity - Consumption Cost Per kWh	\$0.085
<b>Annual Energy Use And Cost Breakdown</b>	Electricity - kWh Per Square Foot Per Year	8.8
	Electricity - Btu Per Square Foot Per Year	29,884
	Electric Cost Per Square Foot Per Year	\$ 1.09
	Fuel - Btu Per Square Foot Per Year	59,092
	Fuel Cost Per Square Foot Per Year	\$ 0.79
<b>Annual Energy Index (AEI)</b>	Total AEI - Btu Per Square Foot Per Year	88,976
	Total Energy Cost Per Square Foot Per Year	\$ 1.88

The annual energy use factors for the building will be further discussed in the following section of this report.

### ***Water & Sewer Offices/Garage – Description of Building and Energy Systems***



The Concord Water & Sewer Division building at 135 Keyes Road comprises 9,700 square feet and includes an office section and garage bays. Typical usage is from 7:00 AM to 5:00 PM weekdays. The building is of block construction. Original construction was circa 1940's; however the spaces were renovated and improved in the late 1990's when the building was acquired by the Concord Public Works Department from the Concord Municipal Lighting Plant.

#### ***HVAC Systems – Office Area***

The office areas of the 135 building are air conditioned by two packaged rooftop units (approximately 5 tons capacity each). One of these units is older and one was installed as part of the late 90's renovation. These units provide cooling only.

Space heating for the office wing is provided by a number of individual electric resistance heating units that incorporate thermal storage mass so that electric consumption for heating can be moved to off-peak hours. These units are problematic to control and are no longer economically advantageous. A plan is in place for removal of the electric heaters. Under this proposed plan the existing rooftop units will be replaced with new units that can provide space heating (gas-fired) as well as cooling. The new units will be controlled via programmable electronic space thermostats.

#### ***Heating & Ventilation Systems – Truck Bays***

The bays (1-3) are heated with three (3) Modine gas-fired unit heaters, each with a conventional wall-mounted space thermostat. There is one exhaust fan (EF-12) in the bay



and two additional exhaust fans (EF-11) serving the chemical storage rooms. The break room is heated with a section of electric baseboard heat (about 20' in length).



**Space Thermostat For Unit Heater**



**Gas-Fired Unit Heater**

### ***Other Systems and General Observations***

The existing lighting systems in the building consist primarily of newer high-efficiency T8 fixtures; however there are some older fixtures in place. Older fixtures include fluorescent fixtures with T12 four-foot lamps and some 250W metal halide fixtures (Main Garage).



**Truck Bay Lighting Fixtures**

Domestic hot water is provided by an electric tank. Plumbing fixtures in the building are all new and are configured for low water use.

The building envelope appears to be in excellent condition. The attic space was observed to be adequately insulated. The exterior windows and doors are all newer and in good condition. The sprayed on insulation above the ceilings appears to be in good condition. The only area in need of improvement (per staff) is the break room in the older garage section. Windows in this area may require air sealing.



**Insulation Above Ceilings**

### *Existing Annual Energy Use*

The Water/Sewer building utilizes electricity purchased from CMLP and natural gas purchased from National Grid. The table below summarizes the recent annual energy use for the building and provides the annual energy usage and costs broken down per square foot of floor area.

<b>Annual Energy Use And Cost Summary</b>		
<b>Water/Sewer - 135 Keyes Road</b>		<b>Square Footage: 9,700</b>
<b>Energy Consumption And Cost Data</b>	Electric Consumption - Annual kWh	107,352
	Total Annual Electric Cost	\$ 16,849
	Natural Gas Consumption - Annual Therms	2,462
	Total Annual Fuel Cost - Natural Gas	\$ 3,562
	<b>Total Annual Energy Cost</b>	<b>\$ 20,411</b>
<b>Unit Costs For Energy</b>	Electricity - Average Cost Per kWh	\$0.157
	Natural Gas - Average Cost Per Therm	\$1.447
	Electricity - Consumption Cost Per kWh	\$0.085
<b>Annual Energy Use And Cost Breakdown</b>	Electricity - kWh Per Square Foot Per Year	11.1
	Electricity - Btu Per Square Foot Per Year	37,772
	Electric Cost Per Square Foot Per Year	\$ 1.74
	Fuel - Btu Per Square Foot Per Year	25,386
	Fuel Cost Per Square Foot Per Year	\$ 0.37
<b>Annual Energy Index (AEI)</b>	Total AEI - Btu Per Square Foot Per Year	63,158
	Total Energy Cost Per Square Foot Per Year	\$ 2.10

The annual energy use factors for the building will be further discussed in the following section of this report.

### ***Planning & Land Management – Description of Building and Energy Systems***



The Concord Planning & Land Management building at 141 Keyes Road comprises 9,841 square feet (including basement) and incorporates two floors of office space and meeting rooms. Typical usage is from 7:00 AM to 5:00 PM weekdays. Staff members arrive at 7 AM, and there is use of the building during the evening hours for public meetings (Monday – Thursday). The building is of brick construction. Original construction was circa 1903 and the building was originally a power plant. A complete renovation was done in 1994 including renovation of the building envelope and interior and new HVAC and lighting systems.

#### ***HVAC Systems***

The building has a hydronic heating loop with a gas-fired Hydrotherm boiler (two modules) and two circulating pumps (each at 1 HP). A Hydrotherm electronic control panel sequences the two modules. The hydronic loop provides forced hot water supply to hot water preheat coils in the two air handling units, reheat coils (seven total) in the HVAC air system, and to eight (8) unit heaters. There are propeller-type unit heaters in the basement and in the attic and a total of six (6) cabinet unit heaters serving stairwells, vestibules, and bath rooms.





**Hydrotherm Boiler**

Ventilation, air conditioning and heating are provided by two air handling units. AC-1 (located in the basement) serves the first floor, and AC-2 (located in the attic) serves the second floor. Each of the two air handling units includes outside and return air dampers, a direct expansion (DX) cooling coil, and a hot water heating coil. Each unit has an outdoor condensing unit as part of the DX cooling cycle.



**AC Unit**

Per the building plans, these two air handling systems are each configured for Variable Air Volume (VAV) operation. There are a total of seven (7) VAV boxes, each with a hot water reheat coil. Each VAV box provides temperature control to an individual zone by throttling the flow of cool air from the air handling unit in response to the space thermostat, with the reheat coil valve then modulating to provide additional heat.



**VAV Box Electronic Controls**

The plans call for a speed controller on each of the AC-1 and AC-2 supply fan motors to provide the airflow modulation (the motors are ½ HP each). The speed controllers were not observed in the field; however they may be internal to the units or the control panels.



**Reheat Coil Hot And Water Valve**

Space temperature controls are electronic and appear to be a mixture of Siebe and Carrier controls. The valve and damper actuators are electronic. Per the building occupants, the temperature control system has been very problematic and continuous manual intervention is required. Contractors have reviewed the temperature control system but have been unable to provide improved operation.



**Temperature Control Panel**



**Hydrotherm Boiler Control Panel**

There are several small exhaust fans in the building, one for the bathrooms and others for attic and boiler roof exhaust.

### ***Other Systems and General Observations***

The original lighting systems in the building have been re-wired for high-efficiency fluorescent T8 systems. Many areas including enclosed offices and conference rooms do not have occupancy sensors for lighting control.

Domestic hot water is provided by a small gas-fired tank. Plumbing fixtures in the building are all new and are configured for low water use.





**Domestic Water Tank**

The building's exterior envelope appears to be in excellent condition. Although the attic space was observed to be adequately insulated, much of the attic ceiling insulation has been disturbed over the years and needs to be tightly re-fitted. There is also some missing or disturbed duct insulation in the attic. The exterior windows and doors are fourteen years old but are still in good condition.



**Attic Insulation**



**Attic Insulation – Disturbed Section**



**Missing Duct Insulation**

### ***Existing Annual Energy Use***

The Planning Department building utilizes electricity purchased from CMLP and natural gas purchased from National Grid. The table below summarizes the recent annual energy use for the building and provides the annual energy usage and costs broken down per square foot of floor area.

<b>Annual Energy Use And Cost Summary</b>		
<b>Planning - 141 Keyes Road</b>		<b>Square Footage: 9,841</b>
<b>Energy Consumption And Cost Data</b>	Electric Consumption - Annual kWh	98,146
	Total Annual Electric Cost	\$ 12,358
	Natural Gas Consumption - Annual Therms	4,121
	Total Annual Fuel Cost - Natural Gas	\$ 5,929
	<b>Total Annual Energy Cost</b>	<b>\$ 18,287</b>
<b>Unit Costs For Energy</b>	Electricity - Average Cost Per kWh	\$0.126
	Natural Gas - Average Cost Per Therm	\$1.439
	Electricity - Consumption Cost Per kWh	\$0.085
<b>Annual Energy Use And Cost Breakdown</b>	Electricity - kWh Per Square Foot Per Year	10.0
	Electricity - Btu Per Square Foot Per Year	34,038
	Electric Cost Per Square Foot Per Year	\$ 1.26
	Fuel - Btu Per Square Foot Per Year	41,879
	Fuel Cost Per Square Foot Per Year	\$ 0.60
<b>Annual Energy Index (AEI)</b>	Total AEI - Btu Per Square Foot Per Year	75,917
	Total Energy Cost Per Square Foot Per Year	\$ 1.86

The annual energy use factors for the building will be further discussed in the following section of this report.

***Police & Fire Station – Description of Building and Energy Systems***



The Concord Police/Fire Department building at 219 Walden Street comprises 14,431 square feet of floor space which includes office space, living quarters, fire truck and apparatus bays, and a holding cell area. Original construction of the building was in 1959. Renovations were done in 1985 and in 2005. The building is occupied 24 hours per day, although some individual office areas are occupied during weekday daytime hours only. The Fire Department section requires 24 hour occupancy; in the Police Department section about 60% of the space is occupied 24 hours per day.

Heat for much of the building is provided by a central gas-fired hot water boiler system. The boiler room houses a two-module Hydrotherm boiler. This boiler is of 1985 vintage and was converted from gas-fired to oil-fired operation. Boiler capacity information is as follows (from the nameplate):

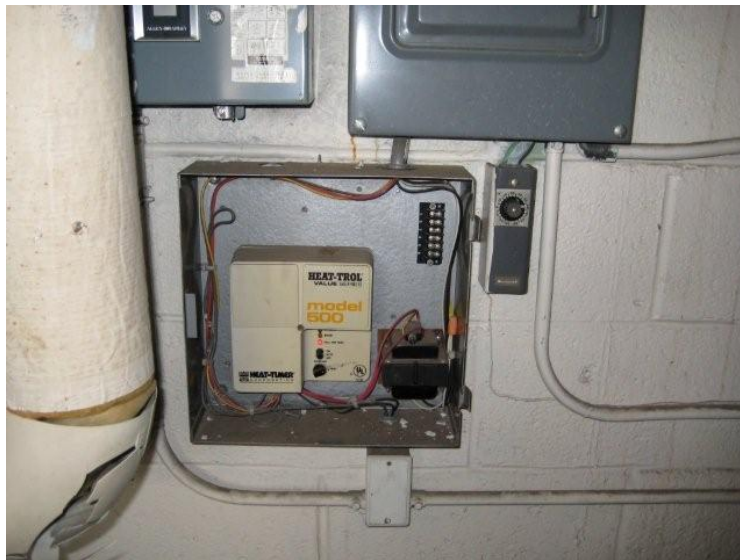
Police/Fire Station Hot Water Boiler	
Manufacturer	Hydrotherm
Model #	MO-770A
Output Capacity - Btu/Hour	606,000
Input Capacity - Fuel Oil GPH	5.5
Calculated Input Btu/Hour	759,000
Calculated Design Efficiency (Oil)	80%





**Boiler And Burners**

While the boiler is older, the burners are relatively new. A recent combustion test indicated an efficiency of 83% under full load conditions. ADI also noted that the existing combustion air intake system for the boiler room would not be in accordance with current building codes. There are two older stand-alone boiler controllers in place; however it appears that the system hot water temperature is controlled to a fixed setpoint with no hot water reset control in place.



**Boiler Controller**

The building has a hot water distribution system with two small in-line circulating pumps (1 ½ HP each) located in the boiler room. The piping loop has a pressure-operated bypass valve and there are two main three-way mixing valves that provide mixed hot water supply to two building zones. It appears that each of the two zone mixing valves is controlled by a space thermostat. ADI noted that there is some missing pipe insulation in the boiler room.





**Hydronic System Circulating Pumps**

The hydronic loop provides forced hot water supply to baseboard fintube convectors in the building and to unit heaters. The Fire Department apparatus bays have four (4) hot water unit heaters, each with a conventional thermostat. There are zone valves associated with the fintube convector systems that also have conventional wall-mounted space thermostats for control.



**Hydronic System Zone Valves**

The various areas of the building are air conditioned and ventilated by a variety of incremental HVAC systems, including window air conditioners, split direct expansion (DX) air conditioning units, and packaged rooftop air conditioning units. There are also some additional incremental heating units including unit heaters, fan coil units, and direct gas-fired rooftop heating and ventilating units. ADI was unable to locate up to date HVAC plans for the building; however an equipment list (prepared in 2007) was available. The following HVAC equipment information is summarized from the equipment list.

Window Air Conditioning Units				
Area Served	Equipment Manufacturer	Quantity	Cooling Capacity Btu/Hour	Cooling Efficiency EER
Fire/Bunk Room	Amana	1	17,800	9.7
Fire/Living Area	Carrier	1	20,000	11.0
Fire Captain	GE	1	17,800	9.7
Fire Chief/Admin	GE	2	5,200	9.7
Medical Office	Freidrich	1	5,600	9.0
Day Room	GE	1	17,800	9.7
Police Gym	Whirlpool	1	24,000	9.0

Split System Air Conditioning Units				
Area Served	Equipment Manufacturer	Quantity	Cooling Capacity Btu/Hour	Cooling Efficiency EER
CID	Carrier	1	60,000	12.7
Third/Computer Room	Carrier	1	18,000	11.5
Squad/Dispatch	Carrier	1	65,000	12.7
Squad/Holding	Lennox	1	30,000	12.7

Packaged Rooftop Air Conditioning Units				
Area Served	Equipment Manufacturer	Quantity	Cooling Capacity Btu/Hour	Cooling Efficiency EER
Third Floor	Carrier	1	90,000	13.0
Third Floor	Carrier	1	65,000	13.0
Second Floor	Carrier	1	71,800	13.0
Cell Block Area	Trane	1	36,000	12.4

Unit Heaters - Supplied By Hydronic Loop And Boiler			
Area Served	Equipment Manufacturer	Quantity	Heating Capacity Btu/Hour
Fire Truck Bays	Modine	4	24,000
Third Floor/Elevator	Sigma	2	16,200
Second Floor/Elevator	Sigma	2	16,200
First Floor/Elevator	Sigma	1	42,500
Day Room	Modine	1	24000

Rooftop Gas-Fired Forced Air Units				
Area Served	Equipment Manufacturer	Quantity	Heating Capacity Btu/Hour	Heating Efficiency
Third Floor Classroom	Reznor	1	200,000	81.0%
Second Floor	Reznor	1	125,000	81.0%

The window air conditioners have built-in thermostatic controls. The other systems are controlled by individual wall-mounted space thermostats. Some of these are simple

heating-only or cooling-only thermostats with single setpoints, while others are electronic (in some cases programmable) thermostats.



**Conventional Mercury Bulb Thermostat**



**Electronic Programmable Thermostat**

In general the systems operate 24 hours per day in all areas. Staff noted that there is often overheating in some areas. ADI believes that overheating may be due to the lack of effective weather-responsive control on the boiler system. It is also possible that due to the absence of centralized control, some systems may be “fighting” each other with the potential for simultaneous heating and cooling. It was noted that the Dispatch area overheats due to the lack of a zone valve in the small space.



**Apparatus Bays – Unit Heaters**

The Fire Department apparatus bays have three exhaust fans and it was noted that the runtime on these fans may be excessive due to inconvenient start/stop control locations. There is an exhaust fan in place for the holding cell areas that runs continuously even if the cells are empty.



**Exhaust Fans**

### ***Other Systems and General Observations***

Lighting systems in the building include a mixture of older fixture types and new efficient lighting fixtures. There are some existing older T12 lamps and ballasts, some incandescent bulbs, and exterior 300W quartz (incandescent) fixtures. Most areas do not have occupancy sensors in place for lighting control.

Domestic hot water is provided by a small gas-fired tank. Plumbing fixtures in the building were observed to be a mixture of older and newer fixtures. Aerators were found on all faucets in the bath rooms. Toilets are of the flushometer type.





**Gas-Fired Domestic Water tank**

The building envelope appears to be in good condition. The third floor ceiling is believed to be adequately insulated since the area was converted from attic space to office space in 2005. It was noted by building staff that in some of the older areas of the building there are spots where the older blown-in insulation has been removed or disturbed as changes were made to the building over the years.



**Third Floor Attic Space Insulation**

There are a few older windows (1959 vintage) in place, and the balance were installed in 1985. The 1985 windows are of the insulated double-pane type. These windows are almost 25 years old and problems have been experienced with some of them.



The Fire Department section has two soda machines; neither was observed to have panel lights. Elsewhere in the building a lighted snack machine was observed.

The Fire Department apparatus bay roll-up doors are new and in good condition.

### ***Existing Annual Energy Use***

The Police and Fire Station utilizes electricity purchased from CMLP and natural gas purchased from National Grid. The table below summarizes the recent annual energy use for the building and provides the annual energy usage and costs broken down per square foot of floor area.

<b>Annual Energy Use And Cost Summary</b>		
<b>Police &amp; Fire Station</b>		<b>Square Footage: 14,431</b>
<b>Energy Consumption And Cost Data</b>	Electric Consumption - Annual kWh	300,809
	Total Annual Electric Cost	\$ 34,747
	Natural Gas Consumption - Annual Therms	14,060
	Total Annual Fuel Cost - Natural Gas	\$ 19,156
	<b>Total Annual Energy Cost</b>	<b>\$ 53,902</b>
<b>Unit Costs For Energy</b>	Electricity - Average Cost Per kWh	\$0.116
	Natural Gas - Average Cost Per Therm	\$1.362
	Electricity - Consumption Cost Per kWh	\$0.085
<b>Annual Energy Use And Cost Breakdown</b>	Electricity - kWh Per Square Foot Per Year	20.8
	Electricity - Btu Per Square Foot Per Year	71,143
	Electric Cost Per Square Foot Per Year	\$ 2.41
	Fuel - Btu Per Square Foot Per Year	97,428
	Fuel Cost Per Square Foot Per Year	\$ 1.33
<b>Annual Energy Index (AEI)</b>	Total AEI - Btu Per Square Foot Per Year	168,571
	Total Energy Cost Per Square Foot Per Year	\$ 3.74

The annual energy use factors for the building will be further discussed in the following section of this report.

***West Concord Fire Station – Description of Building and Energy Systems***



The West Concord Fire Station building at 1201 Main Street comprises 5,204 square feet of floor area and was constructed in 1932. It is a masonry block building with a brick exterior. The second floor was renovated in 1990. The first level houses the apparatus bays and office/dispatch areas. The building is occupied 24 hours per day.

The heating system for the building includes a pair of gas-fired low-pressure steam boilers with a common steam header that supplies steam to unit heaters, radiators, and to an air handling unit that is located in the attic. The system includes a number of steam traps and a new condensate receiver/feedwater system. Staff indicated that the steam traps were evaluated and rebuilt within the last five years. The steam system operates at a pressure setpoint of 10 PSIG.



**Gas-Fired Steam Boilers**

Nameplate information from the boilers is as follows (the two are identical):

<b>West Concord Fire Station Steam Boilers</b>	
Manufacturer	Burnham
Model #	408B
Output Capacity - Btu/Hour	188,500
Input Capacity - Gas Btu/Hour	245,000
Calculated Input Btu/Hour	1
Calculated Design Efficiency	77%
Boiler Quantity	2
Total Boiler Output Capacity Btu/Hour	377,000

The boiler controls are relatively simple with pressure controls to fire the burners and an outside air lockout thermostat set at 65°F. The apparatus bays are heated with three unit heaters with a fourth in the storage area, each with a conventional wall-mounted space thermostat. This area is maintained at 65°F. The dispatch office has steam perimeter heat with a zone thermostat.



**Apparatus Bay Unit Heaters And Steam Traps**



**Steam System – Condensate Tank**

The upper floor is air conditioned by a fan coil unit that is located in the attic. This unit is 20 years old but the associated air-cooled condensing unit is new (about one year old). The unit provides both heating and cooling (about four tons capacity) and is controlled by a conventional wall-mounted space thermostat. This area is occupied 24 hours per day.



**Air Conditioning Ductwork In Attic**



**Air Cooled Condensing Unit**



### ***Other Systems and General Observations***

Lighting systems in the building include a mixture of older fixture types and new efficient lighting fixtures. There are some existing older T12 lamps and ballasts, some incandescent bulbs, and exterior 300W quartz (incandescent) fixtures. Most areas do not have occupancy sensors in place for lighting control.

Domestic hot water is provided by a small gas-fired tank. Plumbing fixtures in the building were observed to be a mixture of older and newer fixtures. Some older tank-type toilets were observed. Staff indicated that water fixtures would be upgraded in the near future under a grant program.



**Gas-Fired Hot Water Tank**

The building envelope appears to be in good condition. The windows are of the double-pane type and were installed about 20 years ago. The roof was redone three years ago. The apparatus bay rollup doors are new (less than one year old) and are in good condition. Attic and wall insulation was observed to be adequate.

The lower level has one soda vending machine.

### ***Existing Annual Energy Use***

The West Concord Fire Station utilizes electricity purchased from CMLP and natural gas purchased from National Grid. The table below summarizes the recent annual energy use for the building and provides the annual energy usage and costs broken down per square foot of floor area.



<b>Annual Energy Use And Cost Summary</b>		
<b>West Concord Fire Station</b>		<b>Square Footage: 5,204</b>
<b>Energy Consumption And Cost Data</b>	Electric Consumption - Annual kWh	39,342
	Total Annual Electric Cost	\$ 5,530
	Natural Gas Consumption - Annual Therms	7,973
	Total Annual Fuel Cost - Natural Gas	\$ 10,905
	<b>Total Annual Energy Cost</b>	<b>\$ 16,436</b>
<b>Unit Costs For Energy</b>	Electricity - Average Cost Per kWh	\$0.141
	Natural Gas - Average Cost Per Therm	\$1.368
	Electricity - Consumption Cost Per kWh	\$0.085
<b>Annual Energy Use And Cost Breakdown</b>	Electricity - kWh Per Square Foot Per Year	7.6
	Electricity - Btu Per Square Foot Per Year	25,802
	Electric Cost Per Square Foot Per Year	\$ 1.06
	Fuel - Btu Per Square Foot Per Year	153,207
	Fuel Cost Per Square Foot Per Year	\$ 2.10
<b>Annual Energy Index (AEI)</b>	Total AEI - Btu Per Square Foot Per Year	179,009
	Total Energy Cost Per Square Foot Per Year	\$ 3.16

The annual energy use factors for the building will be further discussed in the following section of this report.

***Beede Center – Description of Building and Energy Systems***



The Beede Center at 500 Walden Street comprises approximately 34,000 square feet of floor area and was constructed in 2006. The Beede Center is a recreation and exercise facility that houses a large natatorium with four separate pools, exercise rooms and locker rooms. The building is open year round every day with the exception of six holidays per year. It is open from 5:30 AM to 9:00 PM Monday through Friday and from 7:00 AM to 6:00 PM on weekends.

The natatorium includes four pools with dimensions as follows:

Pool Dimensions			
Pool	Length (Feet)	Width (Feet)	Area (Sq. Ft.)
Dive	33.0	40.0	1,320
Lap	75.0	82.0	6,152
Therapy	30.0	19.8	593
Children's	30.0	31.5	945
Total Area:			9,009

The Beede Center has a central hydronic boiler system that includes three Patterson Kelly Thermific hot water boilers. These boilers provide space heating as well as heat for the pool water (via heat exchangers).



**Gas-Fired Boilers**

The main hydronic loop also provides heat to heat domestic hot water using two storage tanks that incorporate integral heat exchangers. Each boiler has a 3 HP primary circulating pump. There are secondary hot water pumps in place as follows:

<b>Pump Service</b>	<b>Motor HP</b>
Pool Heat And Domestic Hot Water	3
Pool Heat And Domestic Hot Water	3
Building Heat	2
Dectron Unit Heat Exchanger	3/4



**Domestic Hot Water Tanks**

The natatorium is conditioned by a Dectron dehumidifier that incorporates a refrigeration cycle with heat recovery from the refrigerant to reheat the air. The Dectron is designed to also provide supplemental heat to heat the pool water; however this is not currently in operation. Building operating staff indicated that a purchase order is in process to put the pool water heating loop into operation. There are four exhaust fans that exhaust air from the natatorium.



**Dectron Unit**

Space conditioning for the balance of the building is provided by six packaged rooftop air conditioning units, each with an air-cooled direct expansion (DX) cooling cycle and a gas-fired heating cycle. These units serve offices, the men's and ladies' locker rooms, the cardio room, the lobby (two units), and the strength training room.

Temperature control systems for the building include a packaged electronic controller (with time clock and unoccupied cycle) for the Dectron unit, a Heat Timer panel to sequence the boilers, and a series of programmable electronic thermostats that control the six packaged rooftop units.



**Boiler Control Panel**

The six programmable thermostats are all mounted on the face of a central control panel and each unit has a remote-mounted space temperature sensor. Building staff indicated that operation of this control system is problematic due to tampering.



**Temperature Control Panel**

### ***Other Systems and General Observations***

Lighting systems in the building are generally “state of the art” in terms of efficiency, with the exception of the natatorium, which has conventional 1,000 Watt metal halide fixtures. The building operating staff is researching a High/Low HID control system for the 24 metal halide fixtures in the pool area.



**Natatorium Lighting – 100 Watt Fixtures**

The pools have no automatic or manual pool covers in place. Pool water is pumped through the filtration systems and circulated continuously using one centrifugal pump per pool (pump motors are 7 ½, 15, 20, and 25 HP). These pumps all run continuously. There are two additional pumps (5 and 7 ½ HP) that circulate water internally in the therapy pool and the children’s pool.





**Pool Water Circulating Pumps**



**Pool Water Heat Exchangers**

The lower level has one bottled beverage vending machine and one snack machine, both with lights.

### ***Existing Annual Energy Use***

The Beede Center utilizes electricity purchased from CMLP and natural gas purchased from National Grid. The table below summarizes the recent annual energy use for the building and provides the annual energy usage and costs broken down per square foot of floor area.

<b>Annual Energy Use And Cost Summary</b>		
<b>Beede Center</b>		<b>Square Footage: 34,000</b>
<b>Energy Consumption And Cost Data</b>	Electric Consumption - Annual kWh	1,225,829
	Total Annual Electric Cost	\$ 114,823
	Natural Gas Consumption - Annual Therms	43,320
	Total Annual Fuel Cost - Natural Gas	\$ 53,872
	<b>Total Annual Energy Cost</b>	<b>\$ 168,695</b>
<b>Unit Costs For Energy</b>	Electricity - Average Cost Per kWh	\$0.094
	Natural Gas - Average Cost Per Therm	\$1.244
	Electricity - Consumption Cost Per kWh	\$0.085
<b>Annual Energy Use And Cost Breakdown</b>	Electricity - kWh Per Square Foot Per Year	36.1
	Electricity - Btu Per Square Foot Per Year	123,052
	Electric Cost Per Square Foot Per Year	\$ 3.38
	Fuel - Btu Per Square Foot Per Year	127,412
	Fuel Cost Per Square Foot Per Year	\$ 1.58
<b>Annual Energy Index (AEI)</b>	Total AEI - Btu Per Square Foot Per Year	250,463
	Total Energy Cost Per Square Foot Per Year	\$ 4.96

The annual energy use factors for the building will be further discussed in the following section of this report.

***Hunt Recreation Facility – Description of Building and Energy Systems***



The Hunt Recreation Facility building at 90 Stow Street comprises 12,492 square feet of floor area and was constructed in 1932 with a renovation of the interior spaces and the HVAC systems done in 1987. It is a masonry block building with a brick exterior. The Hunt Center houses a large gymnasium as well as exercise rooms and an office area.

The building operating schedule is as follows:

<b>Summer (Jul/Aug)</b>	
Mon-Fri	7:30 AM to 8:00 PM
Sat/Sun	12:00 PM to 8:00 PM
<b>School Year</b>	
Mon-Fri	6:00 AM to 9:30 PM
Sat/Sun	9:00 AM to 6:00 PM

The building has a hydronic heating system with a single Weil-McLain hot water boiler. The boiler is gas-fired and was installed as part of the 1987 renovation.



**Gas-Fired Hot Water Boiler**

The hydronic system utilizes two (one redundant) circulating pumps (1 ½ HP). Hot water is circulated to fin-tube perimeter convactor systems, unit heaters, and to heating coils installed in the building's forced air systems. The hydronic system includes a three-way mixing valve for hot water reset control.



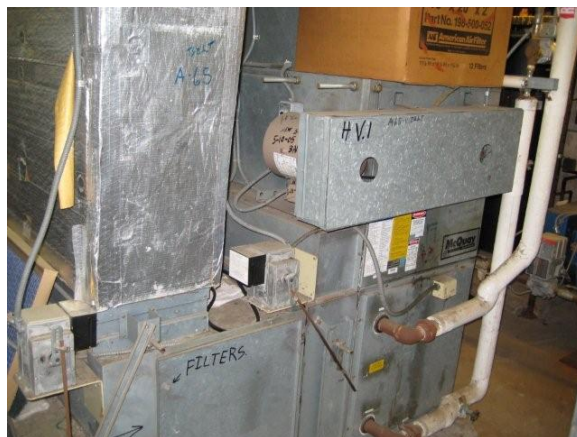
**Hydronic System Circulating Pump**





**Hydronic System Three Way Mixing Valve**

There are two heating and ventilating (H&V) units. HV-1 (3 HP) serves the first floor and HV-2 (5 HP) serves the second floor gymnasium. There is also a small air conditioning unit (AC-1) that serves the first floor office area. AC-1 has a ½ HP supply air fan and an air-cooled direct expansion (DX) split cooling system that has a capacity of three tons. Several small exhaust fans provide exhaust from the locker rooms and from the boiler room. HV-1 supplies the exercise/multipurpose room and the locker rooms; each locker room has a hot water reheat coil for zone control.



**Heating and Ventilating Unit**

Temperature control systems consist of Siebe electronic controls on the H&V units with Barber-Colman electric thermostats controlling perimeter fin tube systems. The electronic control systems have time clocks in place; however it appears that they are not in use. It was noted that some of the perimeter cabinet unit heaters were operating at high heat output.



**Temperature Control Panel**



**Space Thermostats**

### ***Other Systems and General Observations***

Lighting systems in the building (with the exception of the gymnasium) consist of newer T8 fluorescent fixtures with electronic ballasts. At the time of the energy audit, the Gymnasium had a conventional metal halide lighting system with 400 Watt fixtures. Building staff recently had the older gymnasium metal halide lighting replaced with new high-efficiency T5 fluorescent fixtures (234 Watts each) with occupancy sensing controls.



**Gymnasium Lighting (Old System)**



**Gymnasium Lighting (Old System) and H&V Unit**



**New Gymnasium Lighting**

Domestic hot water is provided by a small gas-fired tank. Plumbing fixtures in the building were observed to include newer fixtures including 1.6 GPF toilets and low-flow showerheads.



**Gas-Fired Domestic Water Heating Boiler**

The building envelope appears to be in good condition. Many of the windows are older single pane windows with exterior storm windows. Some areas have had the windows replaced. There was no access available to inspect insulation above the ceiling of the second floor gymnasium; however staff noted that the ceiling had blown-in insulation installed about 20 years ago.



**Older Exterior Window With Storm Window**



The Hunt Recreation facility has an outdoor swimming pool. The pool water is filtered but is not heated. Hunt staff recently had a new high-efficiency pool water pump installed for circulation of the pool water.

### *Existing Annual Energy Use*

The Hunt Recreation Facility utilizes electricity purchased from CMLP and natural gas purchased from National Grid. The table below summarizes the recent annual energy use for the building and provides the annual energy usage and costs broken down per square foot of floor area.

<b>Annual Energy Use And Cost Summary</b>		
<b>Hunt Recreation Facility</b>		<b>Square Footage: 12,492</b>
<b>Energy Consumption And Cost Data</b>	Electric Consumption - Annual kWh	95,242
	Total Annual Electric Cost	\$ 11,728
	Natural Gas Consumption - Annual Therms	7,813
	Total Annual Fuel Cost - Natural Gas	\$ 10,656
	<b>Total Annual Energy Cost</b>	<b>\$ 22,384</b>
<b>Unit Costs For Energy</b>	Electricity - Average Cost Per kWh	\$0.123
	Natural Gas - Average Cost Per Therm	\$1.364
	Electricity - Consumption Cost Per kWh	\$0.085
<b>Annual Energy Use And Cost Breakdown</b>	Electricity - kWh Per Square Foot Per Year	7.6
	Electricity - Btu Per Square Foot Per Year	26,022
	Electric Cost Per Square Foot Per Year	\$ 0.94
	Fuel - Btu Per Square Foot Per Year	62,544
	Fuel Cost Per Square Foot Per Year	\$ 0.85
<b>Annual Energy Index (AEI)</b>	Total AEI - Btu Per Square Foot Per Year	88,566
	Total Energy Cost Per Square Foot Per Year	\$ 1.79

The annual energy use factors for the building will be further discussed in the following section of this report.



## **Section III – Existing Buildings Annual Energy Consumption and Cost**

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### ***Annual Energy Consumption and Cost Summary***

Each of the Town of Concord buildings evaluated utilizes electricity that is purchased from the Concord Municipal Lighting Plant (CMLP) and natural gas that is purchased as a bulk commodity with the local distribution by National Grid USA. Unit costs for electricity are variable per building depending upon the annual consumption and the rate schedule for the particular building. Under the current natural gas contract the commodity cost is \$9.88 per decatherm (\$.988 per therm).

Concord provided ADI with past billing history information including consumption and cost for electricity and natural gas. The consumption and cost data are summarized in the table on the following page, along with the calculated Annual Energy Index (AEI) for each building based on the conditioned square footage.

**Town Of Concord Massachusetts**  
**Summary Of Annual Energy Consumption And Cost**

**Existing Conditions**

Building	Floor Area Square Feet	Electric Consumption Annual kWh	Natural Gas Consumption Annual Therms <sup>1</sup>	Annual Energy Index (AEI) Btu's Per Square Foot Per Year			Annual Energy Costs			Annual Energy Cost Per Sq. Ft.
				Electricity	Fuel	Total	Electricity	Fuel	Total	
Concord Town House	14,838	108,040	6,102	24,851	41,121	65,972	\$ 16,442	\$ 10,209	\$ 26,651	\$1.80
Harvey Wheeler Center	18,000	113,681	13,121	21,555	72,894	94,450	\$ 16,206	\$ 17,538	\$ 33,744	\$1.87
Public Works - 133 Keyes Road	18,268	159,952	10,795	29,884	59,092	88,976	\$ 19,956	\$ 14,472	\$ 34,428	\$1.88
Water/Sewer - 135 Keyes Road	9,700	107,352	2,462	37,772	25,386	63,158	\$ 16,849	\$ 3,562	\$ 20,411	\$2.10
Planning - 141 Keyes Road	9,841	98,146	4,121	34,038	41,879	75,917	\$ 12,358	\$ 5,929	\$ 18,287	\$1.86
Police & Fire Station	14,431	300,809	14,060	71,143	97,428	168,571	\$ 34,747	\$ 19,156	\$ 53,902	\$3.74
West Concord Fire Station	5,204	39,342	7,973	25,802	153,207	179,009	\$ 5,530	\$ 10,905	\$ 16,436	\$3.16
Beebe Center	34,000	1,225,829	43,320	123,052	127,412	250,463	\$ 114,823	\$ 53,872	\$ 168,695	\$4.96
Hunt Recreation Facility	12,492	95,242	7,813	26,022	62,544	88,566	\$ 11,728	\$ 10,656	\$ 22,384	\$1.79
<b>Totals</b>	<b>136,774</b>	<b>2,248,392</b>	<b>109,767</b>	<b>56,105</b>	<b>80,254</b>	<b>136,360</b>	<b>\$ 248,638</b>	<b>\$ 146,300</b>	<b>\$ 394,938</b>	<b>\$2.89</b>

**Note 1:** The natural gas consumption for the Town House was adjusted downward to account for the recent installation of storm windows.

### Review of Current Annual Energy Consumption

ADI reviewed the annual energy consumption values and the Annual Energy Index (AEI) for each building and the consumption indices were analyzed using the EPA Portfolio Manager software. The impact of the Energy Conservation Measures (ECM's) on the AEI for each building is noted here and will be detailed in the next section of this report.

**Concord Town House** –The building is currently relatively energy efficient based on the metrics of annual energy use per square foot. ADI believes that there is potential for some reduction in the annual energy usage. One limitation of this building is that since it is an older structure and a historic building, limited improvements can be made to the building envelope. For example, while new buildings can be built with significant wall insulation, it is very difficult and often impossible to retrofit wall insulation to an existing older building. There are a myriad of technical, logistic, and aesthetic issues that must be surmounted in order to implement building envelope improvements in older structures, and payback periods can be significant even if these issues can be overcome.

All of the mechanical and HVAC systems in the Town House building are relatively new and in good condition. ADI believes that a reduction in the AEI from the current range of 66,000 Btu/SF/Year (estimated based on the existing energy data corrected for the installation of storm windows) to a value in the range of 53,000 will be feasible upon implementation of the ECM's as recommended in this report.

**Wheeler Center** - The building is very efficient since all systems are brand new and in good condition. The AEI is somewhat high as compared to other Town buildings due primarily to the longer hours of operation for community events at Wheeler. ADI believes that a reduction in the AEI from the current range of 94,508 Btu/SF/Year to a value in the range of 70,000 will be feasible upon implementation of the ECM's as recommended in this report.

**Public Works (133 Keyes)** – The CPW building has a relatively high heating/fuel AEI of 59,000. Note that this does not include the waste oil that is consumed to assist with space heating for one of the garage bays. A target for the heating AEI would be in the range of 45,000 or lower, based on the relatively short occupancy schedule and to the fact that the garage bays do not have stringent temperature requirements. ADI believes that both the fuel and electric consumption for the building can be reduced via implementation of the ECM's as recommended in this report.

**Water/Sewer (135 Keyes)** – This building has a relatively low AEI of 63,000 combined for gas and electricity. The fuel AEI is currently very low since the office section uses electric heat. There is a project approved that will replace the existing electric heat with gas heat via new rooftop units. ADI believes that a modest reduction in the AEI of this building is feasible with the implementation of ECM #1 (Lighting Efficiency improvements) and with proper EMS control of the new rooftop units and the existing garage bay unit heaters.

**Planning Department** –The building is relatively efficient since all systems were newly installed 14 years ago and are in good condition. However, there may be some energy waste due to the existing temperature control system. ADI believes that a reduction in the AEI from the current range of 76,000 Btu/SF/Year to a value in the range of 65,000 will be feasible upon implementation of the ECM's as recommended in this report.

**Police & Fire Station** – The Police & Fire station building has high AEI value of 168,000 based on recent energy consumption data. Part of the high value is explained by the building's 24-hour occupancy. However, not all areas require 24-hour space conditioning. A review of similar facilities in other cities and towns indicates that other buildings of this type typically operate with AEI values in the range of 100,000 to 115,000. ADI believes that with the implementation of the ECM's as recommended in this report, in particular a central Energy Management System, the Concord Police & Fire Station can achieve a target AEI in the range of 120,000.

**West Concord Fire Station** – The West Concord Fire station building has a relatively high AEI value of 179,000 based on recent energy consumption data. Part of the high value is explained by the building's 24-hour occupancy. However, the heating usage at 153,000 Btu/SF/year is very high even considering the continuous occupancy. The electric consumption is relatively modest and is in line with other facilities. A review of other Massachusetts fire stations indicates heating AEI values in the range of 60,000 to 100,000 Btu/SF/year for over 2/3 of the buildings reviewed. ADI believes that a significant reduction in heating energy usage for this building is feasible.

**Beede Center** – The Beede Center has a total AEI of 250,000. It is difficult to categorize and compare a building of this type as there are few public buildings of this type and vintage, and facilities with indoor pools have a wide variety of operating scenarios for HVAC and pool heating systems. ADI has identified ECM's projected to significantly lower the AEI for the Beede Center to the range of 200,000.

**Hunt Recreation Facility** – The Hunt Recreation building has an AEI of 88,000. ADI believes that this is somewhat high as compared to what is achievable; however the existing efficiency level is relatively good considering the age of the facility and systems and the long operating hours. ADI believes that with the implementation of the ECM's as recommended in this report, in particular a central Energy Management System, the building can achieve a target AEI of 68,000 to 70,000.

## Section IV – Recommended Energy Conservation Measures (ECM's)

This section provides a description of the Energy Conservation Measures (ECM's) that ADI recommends for further detailed design and potential implementation. The final decision to implement a recommended ECM in a particular building will be dependent upon the Town of Concord's financial criteria, in certain cases upon logistical criteria which will be most familiar to each facility's building manager, and on any future plans for redevelopment or change of use for the buildings. Each ECM if selected for implementation will require further detailed design prior to the bidding and construction phase.

ADI has included some ECM's that have longer simple paybacks (for example, the boiler replacements) if it was believed that the ECM installation would provide significant benefits in terms of capital upgrades and deferred maintenance. Likewise the Energy Management Systems (ECM #2) in some buildings have longer simple payback periods, but are recommended because they provide significant operational and comfort benefits.

### *ECM #1 – High Efficiency Lighting Systems & Controls*

#### **ECM Overview**

The Town of Concord buildings that were investigated by ADI in general have efficient lighting systems already in place. ADI's audit of the buildings revealed some additional opportunities for improvements in the energy efficiency of lighting systems. The recommended lighting ECM's are summarized in this table:

**ECM #1 - High Efficiency Lighting Systems & Controls  
ECM Summary**

Building	Lighting Fixture Retrofits			Lighting Controls Annual kWh Saved	Annual Energy Cost Savings			Opinion Of Probable Project Construction Cost	Simple Payback
	Existing Lighting Systems Annual kWh	New Lighting Systems Annual kWh	Annual kWh Saved		Total Annual kWh Saved	Cost Per kWh	Annual Energy Cost Savings		
Concord Town House	24,397	20,885	3,512	797	4,309	\$0.085	\$ 366	\$ 3,119	8.5
Harvey Wheeler Center	37,970	36,223	1,747	1,080	2,827	\$0.085	\$ 240	\$ 1,800	7.5
Public Works - 133 Keyes	42,889	34,452	8,437	1,752	10,189	\$0.085	\$ 866	\$ 8,807	10.2
Water/Sewer - 135 Keyes	26,692	20,554	6,138	1,348	7,486	\$0.085	\$ 636	\$ 6,614	10.4
Planning - 141 Keyes	14,132	14,132	0	1,346	1,346	\$0.085	\$ 114	\$ 1,455	12.7
Police & Fire Station	88,753	72,498	16,255	2,397	18,652	\$0.085	\$ 1,585	\$ 7,597	4.8
West Concord Fire Station	8,950	6,776	2,174	101	2,275	\$0.085	\$ 193	\$ 1,607	8.3
Beede Center	219,040	219,040	0	26,400	26,400	\$0.085	\$ 2,244	\$ 9,182	4.1
Hunt Recreation Facility	27,234	25,049	2,185	353	2,538	\$0.085	\$ 216	\$ 961	4.5
<b>Totals</b>	<b>490,057</b>	<b>449,608</b>	<b>40,449</b>	<b>35,573</b>	<b>76,021</b>		<b>\$ 6,462</b>	<b>\$ 41,143</b>	<b>6.4</b>

Following is a brief description and summary of the recommended lighting ECM for each building. Detailed lighting audit spreadsheets are included in the appendices of this report.



**Concord Town House** – The Town House has an existing mix of newer T8 and older T12 fluorescent fixtures. ADI recommends the following scope of work for this building under ECM #1:

- Relamp and reballast existing four and eight foot 3 and 2 lamp T12 fixtures (2x4s, wraparounds, industrials and strips) with new 28w T-8 lamps and 2 or 3 lamp high efficiency low ballast factor electronic ballasts. Tandem-wire adjacent fixtures wherever feasible.
- Replace existing exterior 300w Quartz fixtures with new 70w High Pressure Sodium fixtures (or with a similarly less costly fixture to operate if compliance with the Town of Concord's Outdoor Lighting Policy is an issue).
- Install wall and ceiling mounted occupancy sensors in small offices and miscellaneous rooms.
- Replace existing incandescent lamps with new compact fluorescent screw-in lamps.

<b>Concord Town House Lighting Upgrade Project - ECM Summary</b>			
Lighting Systems - Existing Annual kWh	24,397	Lighting Retrofit Cost	\$2,354
Lighting Systems - Proposed Annual kWh	20,885	Occupancy Sensors Cost	\$765
Lighting Retrofit Annual kWh Saved	3,512	<b>Total Cost</b>	<b>\$3,119</b>
Occupancy Sensors Annual kWh Saved	797		
<b>Total Annual kWh Saved</b>	<b>4,309</b>		

**Wheeler Center** – The Wheeler Center building already incorporates all applicable efficient lighting fixtures and occupancy controls in most areas. The following two additional lighting efficiency measures are recommended:

- Provide a means of switching control for the existing “security” lighting circuits so that lights will not be on for 24 hours per day. This will involve having an electrician track down the circuits, isolate the breaker(s) involved, and install one or more new wall switches. Since these are corridor lighting fixtures, occupancy sensors are not recommended.
- For the auditorium, install a ceiling-mounted occupancy sensor and with it as a dry contact input to the existing Quanta Elite lighting panel. Reprogram the panel to turn the lighting circuits on and off based on the occupancy sensor contact closure. ADI has discussed this briefly with ILC, the manufacturer of the panel (800-922-8004).

<b>Harvey Wheeler Center Lighting Upgrade Project - ECM Summary</b>			
Lighting Systems - Existing Annual kWh	37,970	Lighting Retrofit Cost	\$600
Lighting Systems - Proposed Annual kWh	36,223	Occupancy Sensors Cost	\$1,200
Lighting Retrofit Annual kWh Saved	1,747	<b>Total Cost</b>	<b>\$1,800</b>
Occupancy Sensors Annual kWh Saved	1,080		
<b>Total Annual kWh Saved</b>	<b>2,827</b>		

**Public Works (133 Keyes)** – The CPW building has a mixture of older and newer lighting fixtures, including some older metal halide fixtures in the garage bays. ADI recommends the following scope of work for this building under ECM #1:

- Relamp and reballast existing four foot 4, 3, 2 and 1 lamp T12 fixtures (2x4s, wraparounds, industrials and strips) with new 28w T-8 lamps and 1, 2, 3 or 4 lamp high efficiency low ballast factor electronic ballasts. Tandem-wire adjacent fixtures wherever feasible.
- Relamp and Reballast existing eight foot 2 and 1 lamp T12 fixtures (industrials and strips) with new 59w T-8 lamps and 1 and 2 lamp high efficiency low ballast factor electronic ballasts.
- Replace existing 400w Metal Halide fixtures with new 3 lamp 54w/HO T5 fixtures
- Install wall and ceiling mounted occupancy sensors in small offices and miscellaneous rooms.

<b>CPW - 133 Keyes Road</b>			
<b>Lighting Upgrade Project - ECM Summary</b>			
Lighting Systems - Existing Annual kWh	42,889	Lighting Retrofit Cost	\$7,022
Lighting Systems - Proposed Annual kWh	34,452	Occupancy Sensors Cost	\$1,785
Lighting Retrofit Annual kWh Saved	8,437	<b>Total Cost</b>	<b>\$8,807</b>
Occupancy Sensors Annual kWh Saved	1,752		
<b>Total Annual kWh Saved</b>	<b>10,189</b>		

**Water/Sewer (135 Keyes)** – The Water/Sewer building has a mixture of older and newer lighting fixtures, including some older metal halide fixtures in the garage bays. ADI recommends the following scope of work for this building under ECM #1:

- Relamp and Reballast existing four foot 4, 3, 2 and 1 lamp fixtures (2x4s, wraparounds, industrials and strips) with new 28w T-8 lamps and 1, 2, 3 or 4 lamp high efficiency low ballast factor electronic ballasts. Tandem-wire adjacent fixtures wherever feasible.
- Replace existing 250w Metal Halide fixtures with new 3 lamp 54w/HO T5 fixtures
- Install wall and ceiling mounted occupancy sensors in small offices and miscellaneous rooms.

<b>Water/Sewer - 135 Keyes Road</b>			
<b>Lighting Upgrade Project - ECM Summary</b>			
Lighting Systems - Existing Annual kWh	26,692	Lighting Retrofit Cost	\$5,079
Lighting Systems - Proposed Annual kWh	20,554	Occupancy Sensors Cost	\$1,535
Lighting Retrofit Annual kWh Saved	6,138	<b>Total Cost</b>	<b>\$6,614</b>
Occupancy Sensors Annual kWh Saved	1,348		
<b>Total Annual kWh Saved</b>	<b>7,486</b>		

**Planning Department** – The Planning Department building has new T8 and compact fluorescent lighting fixtures in place. ADI did note some potential for the installation of occupancy sensors for lighting control. ADI recommends the following scope of work for this building under ECM #1:

- Install wall and ceiling mounted occupancy sensors in small offices and miscellaneous rooms.

Planning Department - 141 Keyes Road Lighting Upgrade Project - ECM Summary			
Lighting Systems - Existing Annual kWh	14,132	Lighting Retrofit Cost	\$0
Lighting Systems - Proposed Annual kWh	14,132	Occupancy Sensors Cost	\$1,455
Lighting Retrofit Annual kWh Saved	0	<b>Total Cost</b>	<b>\$1,455</b>
Occupancy Sensors Annual kWh Saved	1,346		
<b>Total Annual kWh Saved</b>	<b>1,346</b>		

**Police & Fire Station** – The Police & Fire Station building has a mixture of older and newer lighting fixtures, including some exterior quartz (incandescent) fixtures. ADI recommends the following scope of work for this building under ECM #1:

- Relamp and Reballast existing four foot 4, 3, 2 and 1 lamp T12 fixtures (2x4s, wraparounds, industrials and strips) with new 28w T-8 lamps and 1, 2, 3 or 4 lamp high efficiency low ballast factor electronic ballasts. Tandem-wire adjacent fixtures wherever feasible.
- Replace existing exterior 300w Quartz fixtures with new 70w High Pressure Sodium fixtures
- Install wall and ceiling mounted occupancy sensors in small offices and miscellaneous rooms.
- Replace existing incandescent lamps with new compact fluorescent screw-in lamps

Police & Fire - 219 Walden Street Lighting Upgrade Project - ECM Summary			
Lighting Systems - Existing Annual kWh	88,753	Lighting Retrofit Cost	\$6,407
Lighting Systems - Proposed Annual kWh	72,498	Occupancy Sensors Cost	\$1,190
Lighting Retrofit Annual kWh Saved	16,255	<b>Total Cost</b>	<b>\$7,597</b>
Occupancy Sensors Annual kWh Saved	2,397		
<b>Total Annual kWh Saved</b>	<b>18,652</b>		

**West Concord Fire Station** – The Police & Fire Station building has a mixture of older and newer lighting fixtures, including some exterior quartz (incandescent) fixtures. ADI recommends the following scope of work for this building under ECM #1:

- Relamp and Reballast existing four foot 2 lamp T12 fixtures (2x4s, wraparounds, industrials and strips) with new 28w T-8 lamps and 2 or 4 lamp high efficiency low ballast factor electronic ballasts. Tandem-wire adjacent fixtures wherever feasible.
- Replace existing exterior 300w Quartz fixtures with new 70w High Pressure Sodium fixtures
- Install wall and ceiling mounted occupancy sensors in small offices and miscellaneous room.
- Replace existing incandescent lamps with new compact fluorescent screw-in lamps

## Section IV: Recommended Energy Conservation Measures

West Concord Fire Station Lighting Upgrade Project - ECM Summary			
Lighting Systems - Existing Annual kWh	8,950	Lighting Retrofit Cost	\$1,437
Lighting Systems - Proposed Annual kWh	6,776	Occupancy Sensors Cost	\$170
Lighting Retrofit Annual kWh Saved	2,174	<b>Total Cost</b>	<b>\$1,607</b>
Occupancy Sensors Annual kWh Saved	101		
<b>Total Annual kWh Saved</b>	<b>2,275</b>		

**Beede Center** – The Beede Center has new T8 and compact fluorescent lighting fixtures in place as well as occupancy sensors for lighting control. ADI did note a potential improvement in the natatorium, which is illuminated by 1,000 Watt metal halide fixtures. ADI recommends the following scope of work for this building under ECM #1:

- Install a High/Low HID control system for the 24 - 1000w Metal Halide fixtures in the pool area.

Beede Center - 500 Walden Street Lighting Upgrade Project - ECM Summary			
Lighting Systems - Existing Annual kWh	219,040	Lighting Retrofit Cost	\$182
Lighting Systems - Proposed Annual kWh	219,040	Occupancy Sensors Cost	\$9,000
Lighting Retrofit Annual kWh Saved	0	<b>Total Cost</b>	<b>\$9,182</b>
Occupancy Sensors Annual kWh Saved	26,400		
<b>Total Annual kWh Saved</b>	<b>26,400</b>		

**Hunt Recreation Facility** – The Hunt Recreation Facility has new T8 and compact fluorescent lighting fixtures in place as well as occupancy sensors for lighting control. The facility has recently upgraded the gymnasium lighting to high-efficiency T6 fixtures with occupancy sensors. Therefore the efficient lighting retrofit scope for Hunt is limited to the replacement of existing incandescent fixtures with new compact fluorescents and some occupancy sensor installations.

ADI also noted that many of the exit signs in the facility have older LED retrofit bulbs installed, and in some instances the existing exit signs appear to be under illuminated. Replacement of the old signs with complete new LED signs is recommended as a facility improvement; however no energy savings will accrue.

Hunt Recreation Facility - 90 Stow Street Lighting Upgrade Project - ECM Summary			
Lighting Systems - Existing Annual kWh	27,234	Lighting Retrofit Cost	\$361
Lighting Systems - Proposed Annual kWh	25,049	Occupancy Sensors Cost	\$600
Lighting Retrofit Annual kWh Saved	2,185	<b>Total Cost</b>	<b>\$961</b>
Occupancy Sensors Annual kWh Saved	353		
<b>Total Annual kWh Saved</b>	<b>2,538</b>		

ADI believes that the implementation of the above recommended lighting retrofits in the Town of Concord buildings will result in the following benefits in addition to the annual electrical energy savings:

1. Reduced and deferred maintenance costs due to installation of new lamps and ballasts in many older fixtures.
2. Improved light levels and enhanced environment in office areas, garage bays, and the gymnasium.

3. Simplification of Concord's inventory of replacement lamps and ballasts due to the elimination of T12, incandescent, and metal halide fixtures.



## ***ECM #2 – Energy Management Systems Installation & Upgrade***

### **ECM Overview**

The Town of Concord buildings that were investigated by ADI in most cases incorporate conventional electric and electronic temperature control systems. Only one building – The Harvey Wheeler Center – has an Energy Management System (EMS) that incorporates stand-alone Direct Digital Control (DDC) panels. The other buildings in some cases have local electric or electronic time clocks for unoccupied scheduling and setback control. In other buildings control is strictly manual via adjustment of local wall-mounted thermostats. For the town buildings that were evaluated, there is no central monitoring and control platform in place. The Wheeler Center EMS can only be operated locally in the building.

For improved control and monitoring of Town buildings, ADI recommends the installation of a new web-enabled Energy Management System (EMS) with a color graphics software package that will enable central monitoring and operation from any computer that is connected to the internet (with password protection). For most buildings the recommended EMS would eliminate existing conventional space thermostats so that tampering is not a factor. Temperature control and energy optimization strategies would be implemented via software with remote data gathering and graphing capabilities to enable analysis of operational problems and to fine tune energy control strategies.

ADI has developed a preliminary input and output points estimate for the new EMS For the nine Town of Concord buildings. The new system would incorporate over 700 control and monitoring points as outlined in the Appendix of this report. The table below summarizes the economics of the EMS installation.

**ECM #2 - Energy Management System Installation & Upgrade  
ECM Summary**

<b>Building</b>	<b>Scope Of Work - New EMS Installation Or Upgrade Existing</b>	<b>Annual kWh Saved</b>	<b>Cost Per kWh</b>	<b>Annual Therms Saved</b>	<b>Cost Per Therm</b>	<b>Annual Energy Cost Savings</b>	<b>Opinion Of Probable Project Construction Cost</b>	<b>Simple Payback</b>
Concord Town House	New EMS Installation	21,748	\$0.085	1,081	\$1.48	\$ 3,453	\$ 70,800	20.5
Harvey Wheeler Center	EMS Commissioning & Upgrade	14,867	\$0.085	3,667	\$1.34	\$ 6,165	\$ 24,000	3.9
Public Works - 133 Keyes	New EMS Installation	2,910	\$0.085	2,497	\$1.34	\$ 3,594	\$ 40,200	11.2
Water/Sewer - 135 Keyes	New EMS Installation	1,022	\$0.085	1,462	\$1.45	\$ 2,202	\$ 21,800	9.9
Planning - 141 Keyes	New EMS Installation	4,104	\$0.085	1,037	\$1.44	\$ 1,841	\$ 32,400	17.6
Police & Fire Station	New EMS Installation	13,360	\$0.085	3,339	\$1.36	\$ 5,685	\$ 63,400	11.2
West Concord Fire Station	New EMS Installation	0	\$0.085	1,341	\$1.37	\$ 1,835	\$ 21,600	11.8
Beebe Center	New EMS Installation	23,082	\$0.085	2,523	\$1.24	\$ 5,099	\$ 29,000	5.7
Hunt Recreation Facility	New EMS Installation	8,849	\$0.085	2,143	\$1.36	\$ 3,675	\$ 38,800	10.6
<b>Totals</b>		<b>89,941</b>		<b>19,090</b>		<b>\$33,550</b>	<b>\$ 342,000</b>	<b>10.2</b>

While the EMS installations in some instances have relatively long simple payback periods, other benefits will accrue from having a central EMS:

1. Central monitoring of HVAC and boiler systems operation will leverage the time of building operating staff in handling problems and complaint calls and in insuring that equipment operates properly after service calls.
2. Temperature control will be more even and consistent with “tamper-proof” setpoint control.
3. Having a “state of the art” energy control system in place will provide a tool for expanded operation in the event of future energy price increases.
4. The EMS will provide reporting and trending capability so that parameters such as temperatures, equipment operation, and energy usage can be monitored over time with reports and graphs presented for evaluation of system performance.

In the balance of this section ADI has provided a brief discussion of the existing and recommended controls in each building. The Appendix of this report includes a preliminary allotment of EMS input and output points for each building and for each HVAC sub-system within the building.

**Concord Town House** – The Town House building has electronic control panels in place for the boiler and chiller control, with individual fan coil units and unit heaters having conventional thermostats and integral controls. Under the recommended EMS, all equipment including the boiler plant, chiller, pumps, individual fan coil units and air handling units would be under Direct Digital Control (DDC) via the EMS.

**Wheeler Center** – The Wheeler Center has an existing Honeywell EMS that provides Direct Digital Control of all HVAC equipment. ADI recommends that the existing EMS be integrated into the new system via an integration panel (such as the Tridium system). ADI also recommends that additional points including CO2 sensors be installed so that the system can implement demand-controlled ventilation (DCV).

In addition, ADI recommends that a Retro Commissioning process be performed for the existing Honeywell EMS points and HVAC system control components as part of the integration with the new central EMS. The Retro Commissioning process will insure that existing EMS control points are calibrated properly and are operational and that the existing control sequences provide optimum efficiency in the operation of building systems.

**Public Works (133 Keyes)** – The CPW building has HVAC control via a variety of stand-alone conventional thermostats and an electronic boiler controller. Under the recommended EMS, the existing thermostats, exhaust fan switches, and other local controls would be replaced with new EMS points that would control temperatures using space temperature sensors and DDC control algorithms.

**Water/Sewer (135 Keyes)** – The Water/Sewer building will receive new rooftop HVAC units in the near future for heating and cooling of the office areas. The garage area unit heaters are under control of conventional space thermostats. ADI recommends that the

new rooftop units be put under Direct Digital Control by via the new EMS. The new EMS would also replace the existing thermostats and switches in the garage bays.

**Planning Department** – The Planning Department building has a series of existing stand-alone electronic controls which have been problematic to operate. ADI recommends removing all existing controls, leaving only the end devices like valve and damper actuators in place. The new EMS would then control the existing air handling units, VAV boxes, reheat coil valves, and unit heaters with new control and monitoring points and Direct Digital Control sequences. The new EMS would also control the boiler system, replacing the existing stand alone boiler control panel.

**Police & Fire Station** – The Police & Fire complex has a stand-alone boiler control panel and all other systems are controlled by electric or electronic space thermostats. Under the recommended EMS, all of the split and packages AC units, gas heating units, the boiler and pumps, and existing zone valves would all be put under Direct Digital Control with new EMS points. ADI also recommends a review of the hydronic system piping and zoning with new zone valves installed under EMS control in areas which currently experience overheating.

**West Concord Fire Station** – This building has a relatively simple steam perimeter heating system. There are unit heaters, one AC unit, and a few existing zone steam valves that are controlled by conventional space thermostats. The two steam boilers operate on simple pressure controls. ADI recommends the installation of an EMS with control and monitoring points to replace existing thermostats and to control and sequence the boilers. ADI also recommends a review of the steam heating system piping and zoning with new zone steam valves installed under EMS control in areas which currently experience overheating.

**Beede Center** – The Beede center packaged rooftop HVAC units are controlled by electronic programmable space thermostats. Tampering with the thermostats often occurs, and there is a lack of central monitoring capability. ADI recommends removal of the existing programmable thermostats and the installation of a new EMS to provide Direct Digital Control of the rooftop units, with new CO2 sensors added for demand-controlled ventilation for the lobbies and the exercise rooms. ADI does not recommend that the boilers or the Dectron unit be put under EMS control initially, as these systems cannot be scheduled in operation due to the requirements to maintain pool and natatorium conditions 24 hours per day.

**Hunt Recreation Facility** – The Hunt Recreation Facility has a system of stand-alone electronic controls which appear to be in disrepair. ADI recommends removing all existing controls, leaving only the end devices like valve and damper actuators in place. The new EMS would then control the heating and ventilating units, AC unit, unit heaters, and the boiler system with new control and monitoring points and Direct Digital Control sequences.

## ***ECM #2 – Energy Management System Alternate – Smart Grid System***

The Concord Municipal Light Plant (CMLP) is in the planning stages for the implementation of a control system for the Town buildings. The control system is referred to as the Smart Grid system and will involve the installation of controllers for HVAC and other equipment in the buildings. ADI attended a meeting at CMLP for a discussion of the Smart Grid system and its impact on the implementation of the recommended Energy Management System. While detailed plans and equipment specifications for the installation of the Smart Grid controllers in the Town buildings have not yet been drawn up, CMLP representatives did discuss the proposed functionality of the Smart Grid system.

Based on the discussions with CMLP staff, ADI understands that the basic elements and functionality of the Smart Grid system will be as follows:

- The Smart Grid system will utilize wireless “smart thermostats” for HVAC control. These thermostats will replace existing conventional thermostats.
- The Smart Grid thermostats and controllers will be used to provide scheduling control of HVAC equipment and to provide implementation of temperature setpoint control.
- The Smart Grid system will provide energy savings functions related to controlling building electric demand during periods of peak demand.
- Town staff including building managers will have access to the system via the internet to change HVAC equipment operating schedules and setpoints.

ADI raised some questions about the implementation of the Smart Grid system based on our knowledge of the HVAC systems and controls in the nine Town buildings that are part of this audit. Due to the fact that the Smart Grid system is still in the planning stages, detailed answers to some of our questions were not available. Based on the items that were discussed, ADI has the following general comments regarding the implementation of the Smart Grid controllers in the Town buildings.

1. It is not clear how the Smart Grid system will interface with more complex existing HVAC controls (modulating valves, modulating economizer dampers, and other controls that go beyond on/off control).
2. Since the focus is on the control of electrical systems, control of the boilers in the buildings will not be implemented using Smart Grid. This will also be true of other smaller heating-only equipment (unit heaters and terminal units like individual steam heating zones).
3. The focus of the Smart Grid system will be on the HVAC terminal equipment (air handling units, rooftop units, fancoil units, etc) and not on central equipment (chiller and chilled water pumps at the Town House).

4. It has not been determined how the Smart Grid controllers will interface with (or replace) the existing Honeywell Energy Management System at the Wheeler Center.

Based on the description provided by CMLP staff, and conditional upon answers to items #1 through #4 above, ADI believes that the Smart Grid system can provide two of the principal functions of the EMS as recommended under ECM #2. The two major energy savings functions of the EMS/Smart Grid are to implement scheduling control of equipment and temperature setpoint control. CMLP staff have indicated that Smart Grid will provide these functions. Therefore based on the limited information received to date, ADI believes that the Smart Grid system would be a viable alternative for implementation in the Town buildings that would provide most of the annual energy savings as predicted for the EMS.

ADI does believe that the installation of an EMS (which could possibly be done in combination with Smart Grid) would provide some additional benefits to the Town (as compared to the Smart Grid system alone) as follows:

- The EMS would incorporate many points for equipment monitoring, with trending and reporting for evaluation of equipment performance.
- The EMS can provide remote alarms in the event of HVAC equipment failures.
- The EMS will address control of the boilers and hot water system pumps, which the Smart Grid controllers will not address. The same is true of heating zones including hydronic and steam zone valves in some buildings.
- The EMS can implement energy savings strategies beyond scheduling and setpoint control, including economizer control and demand-controlled ventilation strategies.

As CMLP provides more detailed information regarding the implementation of the Smart Grid system, ADI recommends that the Town evaluate the potential benefits of the Smart Grid system as compared to the EMS or a combined approach.



### ***ECM #3 – Boiler Replacements***

Most of the Town of Concord buildings reviewed by ADI were found to have relatively new and efficient gas-fired boilers in place. ADI evaluated replacement of existing boilers in the Police & Fire Station and in the West Concord Fire Station since these two building were found to have older boilers and both have relatively high fuel usage in units consumed annually per square foot. The Hunt Recreation Facility also has an older boiler; however boiler replacement for this building was not evaluated since the facility has a lower fuel usage intensity.

The table below summarizes the economics of the boiler replacements. ADI evaluated the annual energy savings for each building with the assumption that the building would be under EMS control per ECM #2. The base fuel usage for each building for evaluation of the boiler replacement was reduced based on improved efficiency with the EMS.

#### **ECM #3 - Boiler Replacements ECM Summary**

<b>Building</b>	<b>Natural Gas Annual Therms Saved</b>	<b>Cost Per Therm</b>	<b>Annual Energy Cost Savings</b>	<b>Opinion Of Probable Project Construction Cost</b>	<b>Simple Payback</b>
Police & Fire Station	2,614	\$1.36	\$ 3,561	\$ 48,415	13.6
West Concord Fire Station	1,548	\$1.37	\$ 2,117	\$ 32,085	15.2
	<b>4,161</b>		<b>\$ 5,678</b>	<b>\$ 80,500</b>	<b>14.2</b>

**Police & Fire Station** – The Police & Fire Station building has an older gas-fired hot water boiler. ADI recommends replacement with a new high-efficiency condensing hot water boiler with hot water reset control.

**West Concord Fire Station** – The West Concord Fire Station has a pair of gas-fired steam boilers. ADI recommends replacement with two new steam boilers. As part of the replacement project, ADI recommends that a sizing and capacity calculation be done to size the new boilers properly and to insure the best seasonal energy efficiency. Existing steam traps should be evaluated for proper operation as part of the boiler installation.

### ***ECM #4 – Pool Pumps – Variable Frequency Drives***

The existing pool water circulating pumps at the Beede Center currently operate with fixed speed motors. It is believed that the existing pumps (with the exception of the Therapy pool pump) are oversized based on the required turnover rate for each pool through the water filtration equipment. The installation of Variable Frequency Drives (VFD's) on the pool water pump motors would provide a means of manual or automatic flow variation. For a fixed-flow water system a small reduction in pump speed will produce a relatively large reduction in the input power to the pump motor.

The installation of VFD's on the pool water pump motors has the potential to save energy by enabling speed control of the pumps. Speed could be varied based on the following factors:

1. The total turnover rate could possibly be reduced while maintaining water quality. A small reduction in the turnover rate would produce significant pump energy savings.
2. The turnover rate may be reduced during unoccupied hours, either with the pools in their current uncovered configuration or in conjunction with the installation of pool covers (ECM #5).
3. The pump speeds can be lowered when the filters are clean and then ramped up gradually as the filters make up. It is likely that the pumps were sized and selected based on a high filter pressure drop, so turnover rates may be high when the filters are clean.

ADI recommends that Beede Center staff consult with a pool maintenance company in order to determine the potential impact of a reduction in the turnover rate on water quality (including experience at other similar facilities). A detailed design phase for this ECM would follow in order to determine the exact control sequences required and the best method to implement changes in the pump speeds based on critical factors.

This table summarizes the existing pool turnover rates as compared to code required rates and those recommended by the NSPF:

<b>Pool</b>	<b>Code Required Turnover Hours</b>	<b>NSPF Turnover Hours</b>	<b>Existing Pump Design GPM</b>	<b>Pool Water Content Gallons</b>	<b>Existing Turnover Minutes</b>	<b>Existing Turnover Hours</b>
Dive Pool	8	6	910	123,750	136	2.3
Lap Pool	8	6	1,050	297,369	283	4.7
Therapy	1/2	1/2	515	15,500	30	0.5
Children's	4	3	295	7,000	24	0.4

The numbers in the table indicate that there is potential to reduce the pool water flow rates consistent with code requirements and with NSPF recommendations for three out of

the four pools. The Therapy pool design value for turnover is not above those recommended so it would not be included under this ECM.

ADI has developed an energy savings calculation for the installation of VFD's on the pool water pump motors based on estimates of speed settings that we believe are relatively conservative. The savings calculations assume that NSPF levels would be maintained under typical occupied conditions then reductions in speed would be made to lower the turnover rates to code required levels during unoccupied periods. ADI has applied some safety factors to these reduced flow rates for conservatism in the calculations.

ADI also evaluated the replacement of the existing pool water pump motors with new premium efficiency motors. While the existing pump motors are of *high* efficiency, new *premium* efficiency motors will have slightly higher efficiency levels. The motor replacement was evaluated both as a stand-alone energy conservation measure and combined with the VFD installation.

The ECM summary table below summarizes the economics of the motor replacement alone as compared to the motor and VFD installation and the installation of VFD's only. Motor prices were obtained from Baldor. Pricing for the installation of VFD's was obtained from a quotation that was previously submitted by South Shore Gunitite Pool & Spa Inc. South Shore Gunitite submitted a price for the Dive, Children's, and Lap pools, since the Therapy pool would not benefit from reduced water turnover. ADI added an additional cost allowance for controls to the pricing in the proposal.

The savings, cost, and payback information presented here include ECM implementation for the Dive, Lap, and Children's pools. As shown in the table, the replacement of the motors only has a long payback and is therefore not recommended. The installation of VFD's on the existing pump motors has the quickest simple payback period and is the recommended option.

**Town Of Concord                      Beede Center**  
**ECM #4 - Pool Pumps - Variable Frequency Drives**  
**ECM Summary**

ECM Option	Annual kWh Saved	Cost Per kWh	Annual Cost Savings	Probable Construction Cost	Simple Payback
Premium Efficiency Motors Only	5,560	\$0.085	\$ 473	\$ 10,100	21.4
Variable Frequency Drives With New Premium Efficiency Motors	202,570	\$0.085	\$ 17,218	\$ 37,820	2.2
Variable Frequency Drives With Existing Motors	192,395	\$0.085	\$ 16,354	\$ 30,070	1.8

### ***ECM #5 – Automatic Pool Covers***

The four pools in the Beede Center natatorium currently are open to the space all of the time since there are no existing pool covers in place for use by facility staff. The installation and use of automatic pool covers would provide energy and water savings due to the elimination of evaporation from the pool water surface during unoccupied hours. Electrical energy savings would also result from reduced operation of the Dectron unit.

ADI reviewed the potential for pool cover installation with Alta Enterprises and a preliminary selection and pricing was obtained for the Dive, Lap, and Therapy pools. The pool covers would operate automatically from reels that would be mounted on the natatorium walls adjacent to the pools. The Children's pool is not included due to the obstructions posed by the play structures in the pool.

This table summarizes the economics of the pool cover installation:

**Town Of Concord                      Beede Center**  
**ECM #5 - Pool Covers - ECM Summary**

<b>Dectron Unit Annual kWh Saved</b>	<b>Cost Per kWh</b>	<b>Pool Makeup Water Heating Annual Therms Saved</b>	<b>Cost Per Therm</b>	<b>Annual Energy Cost Savings</b>	<b>Opinion Of Probable Project Construction Cost</b>	<b>Simple Payback</b>
61,505	\$0.09	8,896	\$1.24	\$ 16,291	\$ 110,346	6.8

<b>Pool Makeup Water Annual kGal Saved</b>	<b>Water Cost Per kGal</b>	<b>Annual Water Cost Savings</b>	<b>Total Energy And Water Cost Savings</b>	<b>Simple Payback With Water Cost Savings</b>
84	\$16.80	\$ 1,416	\$ 17,707	6.2

### ***Recommended Operations And Maintenance (O&M) Measures***

The above sections have outlined ADI's recommended Energy Conservation Measures (ECM's) that are considered to be *capital* Energy Conservation Measures. Capital ECM's are those that require a significant up front capital investment that is returned over time as annual energy cost savings accrue. In addition to capital ECM's, There are a number of energy savings measures that are generally considered to be Operations and Maintenance or O&M measures. ADI recommends that the following O&M's be implemented in addition to normal maintenance including HVAC system maintenance, boiler cleaning, etc.

#### ***O&M #1 – Weatherization Improvements***

In general the Concord town buildings have building envelopes that are in good condition and attic and roof spaces have insulation in place where it is feasible to do so. However, there are some instances in which the existing insulation is damaged or has shifted and could be improved. There are also exterior doors in many areas that could be improved from an efficiency standpoint with the installation or repair of weather-stripping. Also, many older buildings have minor air leaks due to wall penetrations. Often the air leakage or in some instances damaged or missing insulation is invisible to the naked eye.

The excess infiltration of fresh air results in energy waste since this air must be heated or cooled to the required space temperature. Likewise damaged or missing insulation can result in excessive heat gain or heat loss. Under this ECM, ADI recommends that a program of inspection, weatherization and air sealing be implemented as follows:

- Utilize a weatherization contractor to perform assessments using an infrared camera and blower door testing in order to determine areas of air leakage and missing or deficient/damaged insulation. Use the results of these surveys to implement upgrades as follows.
- Inspect exterior windows and caulk any air leaks with an appropriate material.
- Inspect window seals and repair or replace as necessary.
- Inspect electrical outlets that are located on exterior walls and install gaskets for air sealing.
- Inspect door seals and weather stripping. Caulk around doors as necessary, repair or replace weather stripping, and install door jamb seals on smaller doors. Repair or replace gaskets on larger doors as necessary.
- Inspect the building roof/wall joints (in the attic interior) and seal any gaps or openings.
- Inspect any penetrations to exterior walls for conduits or other equipment and caulk or seal any air gaps around the penetrations.



- Utilize infrared testing results to determine where insulation is missing or deficient. Repair or replace as necessary. Repair or replace missing pipe and duct insulation.

Some specific buildings and area for improvement in the Town of Concord buildings are noted here:

**Town House:** There is missing insulation in the ceiling above the lunch room and rear office area. The attic of the building is insulated but the insulation is missing or has shifted in some areas. The attic should be inspected for air leaks at the roof/wall joints.

Exterior doors in the Town House are older and are not insulating doors. However, due to the historic nature of the building, it may not be feasible to replace the doors. ADI recommends that Concord consider weather stripping the exterior doors.

The Town House has no wall insulation. While energy savings would accrue from insulating the walls, ADI believes that based on the type of construction adding wall insulation would be a difficult and expensive task. Given that the annual fuel usage is only 46,000 Btu/SF/year (without the new storm windows in place), the annual heating energy savings would be limited. For example, if insulating the walls were to save 20% of the annual heating energy usage (a reasonable estimate), the annual fuel cost savings would be less than \$2,000 per year. The simple payback would likely be over 20 years given the level of disruption required, if the project were even feasible. ADI does recommend that if a complete building renovation is planned in the future for the Town House, that adding wall insulation be considered at that time.

**Planning Department Building – 141 Keyes Road:** This building has an insulated attic but the insulation is missing or has shifted in some areas. The attic should be inspected for air leaks at the roof/wall joints. Some missing duct insulation was noted in the attic. The crawlspace should also be inspected for adequate insulation.

**Police/Fire Station:** This building should be assessed for adequate insulation in ceiling areas. Exterior doors and windows should be evaluated for air leakage.

**West Concord Fire Station:** This building should be assessed for adequate insulation and air sealing in the attic. Another weatherization measure would be to install a fan in the attic to exhaust heat and reduce the cooling load on the air conditioning system. Exterior doors and windows should be evaluated for air leakage.

**Hunt Center:** Exterior doors and windows should be evaluated for air leakage.

**Water Department – 135 Keyes Road:** Exterior doors should be evaluated for air leakage. The building roof should be evaluated for adequate insulation.

**Public Works – 133 Keyes Road:** Exterior doors should be evaluated for air leakage. The building roof should be evaluated for adequate insulation. Exterior walls should be evaluated in areas where cold complaints have occurred in the winter.

### ***O&M #2 – Appliance Replacement And Maintenance***

Appliances can be significant energy consumers. Several of the Town of Concord buildings have refrigerators, stoves, and washers and dryers. In general, stoves do not have high-efficiency replacements. The only efficiency improvement for a (gas) stove would be to replace a stove with pilot lights with a new electric ignition stove. However, due to the low energy usage of a standing pilot, the energy savings would be very small. Clothes washers and dryers can be significant energy users. The washers and dryers can be significant energy users. However, the few washers and dryers observed in the Town buildings are new efficient models.

Refrigerators are perhaps the most significant of the appliances in terms of energy use. ADI observed that most of the refrigerators in the Town buildings are relatively new (1990's or later). New *Energy Star* rated refrigerators will provide some annual energy savings as compared to typical refrigerators manufactured even into the early 2000's. The following chart (based on an 18 cubic foot refrigerator) provides a guideline as to the annual energy cost savings that will accrue for the Town of Concord buildings based on the replacement of older refrigerators with new *Energy Star* rated refrigerators.

Existing Refrigerator Year Manufactured	Annual Energy Cost		
	Existing Refrigerator	New Energy Star Refrigerator	Annual Savings
1980-1989	\$140	\$34	\$106
1990-1992	\$105	\$34	\$71
1993-2000	\$70	\$34	\$36
2001-2008	\$45	\$34	\$11

Based on the above chart a refrigerator replacement will provide annual energy cost savings of between \$11 per year for the replacement of a newer refrigerator to \$106 per year for the replacement of a 20 to 30 year old refrigerator. For a new refrigerator costing about \$750, the simple payback would range from seven years to 68 years. The Town of Concord may be able to purchase *Energy Star* rated refrigerators at lower cost if purchased in quantity.

Regarding existing refrigerators, energy efficiency can be maintained by annually cleaning the condenser coils on each refrigerator, and by inspecting the door gaskets on the refrigerator doors.

### ***O&M #3 – Energy Star Features – Computers And Office Equipment***

Several of the Town of Concord buildings have a significant load for office equipment in the open office areas and the enclosed offices, including computers, monitors, printers, and copiers. It is possible that some of this equipment is left on overnight and during weekends and holidays. Many computers and other pieces of office equipment, if recently purchased, have built-in *Energy Star* features that can be configured to either partially or completely shut the equipment down during idle periods. These features have to be enabled in order to operate and provide energy savings.

ADI recommends that the Town review all existing equipment in the buildings to make sure that *Energy Star* features are enabled. Implement a program with IT staff involvement for education, training, and awareness of *Energy Star* features in existing equipment and when new equipment is purchased.

### ***O&M #5 – Vending Machine Replacement***

Several of the Town of Concord buildings have existing vending machines for snacks and soda. Snack machines have low electric loads (limited to the light fixture if there is one in place). Soda machines have refrigerated compartments similar to household refrigerators, in addition to (in some instances) panel lights. Panel light son vending machines can be disconnected (in most cases this has already been done) to save energy. Most of the older vending machines are owned by the Town. While some energy savings would accrue from the replacement of older soda vending machines with newer more efficient machines, the cost of new vending machines is quite high relative to the small potential savings.

For vending machines that are Town-owned, ADI recommends that Concord consider having an outside vending company place machines in the buildings so that older less efficient machines can be removed. The vending company would be required to place new high efficiency machines that incorporate energy saving features. If this approach were to be used, the Town would accrue annual energy cost savings at no up front capital cost.

As an alternate, where feasible (based on the building occupancy), ADI recommends the installation of plug-in timers to shut vending machines off during the hours when the buildings are unoccupied. This would not apply to the Police/Fire Station and the West Concord Fire Station since these buildings are continuously occupied.

### ***O&M #6 – Temperature Setpoint Maintenance***

Significant energy waste can accrue if temperature setpoints for space temperatures are maintained at levels too high (in heating) or too low (in cooling), or if domestic hot water temperatures are maintained at levels that are too high. ADI recommends that the Town of Concord develop standards for temperatures to be maintained in buildings and for domestic hot water systems. The standards should be based on Massachusetts code requirements and implemented via the individual building managers.

### ***Energy Conservation Measures Considered But Not Recommended***

ADI considered a number of other ECM's for the Town of Concord buildings, and preliminary analyses were performed. The potential ECM's as described in this section were considered but are not recommended for implementation due to long payback periods or other constraints.

**Boiler Replacements:** Most of the Town buildings that incorporate hydronic heating systems have relatively new boilers that are in good condition and have high efficiency levels. ADI has evaluated boiler replacements for two buildings under ECM #3. The only other candidate for boiler replacement due to the age of the boiler is the Hunt Recreation Facility. ADI did not evaluate a boiler replacement for this building due to the fact that the annual heating fuel usage per square foot is relatively low. Boiler replacements generally have a long payback period even for buildings with a high intensity of usage.

**Window Replacements:** Many of the Town buildings have new or relatively new double-pane windows or in some buildings older windows with storm windows. The older windows could be replaced with new double-pane windows and some energy savings would result. However, ADI has evaluated window replacements in many similar buildings and the simple payback period on energy savings alone is usually in excess of 90 years. This is due to the high cost of replacement windows. Some of the Concord buildings offer additional cost challenges for window replacement due to the age and historic nature of the buildings.

**Gas-Fired Radiant Heating:** On new construction, gas-fired radiant heat is often used for garages and other high-bay utility areas. ADI considered recommending the installation of radiant heat in the CPW and Water/Sewer garage bays and in the Concord Fire Department apparatus bays. Based on analyses done for other projects, ADI believes that the payback period would be quite long, due to the fact that relatively low temperature setpoints are currently maintained in these areas. It is also believed that the fire apparatus bays have ceilings that are too low for the effective installation of radiant heat.

**Vending Machine Controllers:** The Town buildings have a few soda vending machines in place; however it was noted that the machines in place do not have lighted front panels (therefore already saving energy). Vending machine controllers are only cost effective if applied on older (non-electronic) machines that have lighted panels, as much of the savings are accrued from control of the panel lights.

**Solar Thermal System – Pool Heating:** The Beede Center could utilize a solar water heating system to provide some portion of the heat required for heating of domestic hot water and for the pool heat. ADI has performed a number of detailed investigations of solar water heating for other municipal buildings in Massachusetts and the simple payback periods are generally in the range of 40 years or longer.

**Timed Automatic Door Closers:** At the fire stations, staff observed that in some instances the bay doors remain open after the trucks have left for a call, wasting heating energy in the winter. It was noted that an automatic closure system would result in some energy savings. ADI is not aware of a practical method for automatically closing the bay doors while at the same time maintaining safety for trucks to leave in an emergency situation. For the relatively few times per year that this situation will occur, extra vigilance on the part of building staff may be the most expeditious method for insuring that the doors close at the correct time.

**Water Conservation:** Working with the Water Department, the Town has already installed efficient water fixtures in all buildings (in some buildings the replacements are still in progress). Concord has installed low-flow urinals, waterless urinals, low-flush toilets, low-flow showerheads, and dual-flush toilets. In some of the older buildings, waterless urinals cannot be installed due to the existing plumbing conditions. Based on what was observed, ADI believes that the Town has implemented all applicable water conservation measures in the buildings evaluated.



## **Appendix A – ECM #1**

Town of Concord  
Town House  
ECM: Lighting Improvements

\$/kWh 0.085  
\$/kW -

Location		Existing Conditions						Retrofit Conditions								Sensors		Retrofit Savings		Sensor Savings		Total Savings	
Item #	Room #	Code	# Of Fxts	Existing Fixture	Watts	kW	kWh	Code	# Of Fxts	Replacement Fixture	Watts	kW	kWh	H (h/yr)	FC	Sw Mt.	Ceil Mt.	kW Saved	kWh Saved	kW Saved	kWh Saved	Demand kW Reduction	kWh/year Saved
1	boiler rm	37	2	8'-STR-2LF96/EE/EEM	123	0.25	123	175	2	2LF59/LBF	100	0.2	100	500		0	0	1.0	23	0.00	0	0.00	23
2	basement	37	7	8'-STR-2LF96/EE/EEM	123	0.86	1722	175	7	2LF59/LBF	100	0.7	1400	2000		0	0	0.2	322	0.00	0	0.00	322
3	basement	34	4	4'-STR-2LF40/EE/EEM	70	0.28	560	105	4	2LF28/HE/LBF	42	0.2	336	2000		0	0	0.1	224	0.00	0	0.00	224
4	server rm	37	2	8'-STR-2LF96/EE/EEM	123	0.25	49	175	2	2LF59/LBF	100	0.2	40	200		0	0	0.0	9	0.00	0	0.00	9
5	attic	37	2	8'-STR-2LF96/EE/EEM	123	0.25	49	175	2	2LF59/LBF	100	0.2	40	200		0	0	0.0	9	0.00	0	0.00	9
6	attic	34	1	4'-STR-2LF40/EE/EEM	70	0.07	14	105	1	2LF28/HE/LBF	42	0.0	8	200		0	0	0.0	6	0.00	0	0.00	6
7	exterior	58	2	QUARTZ-IL300W	300	0.60	2400	162	2	70W HPS MINI-FLOOD	90	0.2	720	4000		0	0	0.4	1680	0.00	0	0.00	1680
8	front lobby	74	15	2L-13W CF	30	0.45	1125	100	15	NO-RETRO	30	0.5	1125	2500		0	0	0.0	0	0.00	0	0.00	0
9	large open office	72	46	2x2-2LFB30/T8	45	2.07	5175	100	46	NO-RETRO	45	2.1	5175	2500		0	0	0.0	0	0.00	0	0.00	0
10	office 1	72	4	2x2-2LFB30/T8	45	0.18	450	100	4	NO-RETRO	45	0.2	450	2500		1	0	0.0	0	0.00	113	0.00	113
	office 2	72	4	2x2-2LFB30/T8	45	0.18	450	101	4	0.000	0	0.0	0	2500		1	0	0.2	450	0.00	0	0.00	450
11	office 3	72	4	2x2-2LFB30/T8	45	0.18	450	100	4	NO-RETRO	45	0.2	450	2500		1	0	0.0	0	0.00	113	0.00	113
12	office 4	72	7	2x2-2LFB30/T8	45	0.32	788	100	7	NO-RETRO	45	0.3	788	2500		0	0	0.0	0	0.00	0	0.00	0
13	office 5	72	4	2x2-2LFB30/T8	45	0.18	450	100	4	NO-RETRO	45	0.2	450	2500		0	0	0.0	0	0.00	0	0.00	0
14	office 6	72	4	2x2-2LFB30/T8	45	0.18	450	100	4	NO-RETRO	45	0.2	450	2500		1	0	0.0	0	0.00	113	0.00	113
15	office 7	72	2	2x2-2LFB30/T8	45	0.09	225	100	2	NO-RETRO	45	0.1	225	2500		0	0	0.0	0	0.00	0	0.00	0
16	office 8	72	2	2x2-2LFB30/T8	45	0.09	225	100	2	NO-RETRO	45	0.1	225	2500		0	0	0.0	0	0.00	0	0.00	0
17	office 9	72	6	2x2-2LFB30/T8	45	0.27	675	100	6	NO-RETRO	45	0.3	675	2500		0	0	0.0	0	0.00	0	0.00	0
18	2nd fl conf rm	49	6	INCAND-1L/150W	150	0.90	450	100	6	NO-RETRO	150	0.9	450	500		0	0	0.0	0	0.00	0	0.00	0
19	2nd fl office 1	72	4	2x2-2LFB30/T8	45	0.18	450	100	4	NO-RETRO	45	0.2	450	2500		1	0	0.0	0	0.00	113	0.00	113
20	2nd fl office 2	72	4	2x2-2LFB30/T8	45	0.18	450	100	4	NO-RETRO	45	0.2	450	2500		0	0	0.0	0	0.00	0	0.00	0
21	2nd fl office 1	72	4	2x2-2LFB30/T8	45	0.18	450	100	4	NO-RETRO	45	0.2	450	2500		1	0	0.0	0	0.00	113	0.00	113
22	2nd fl office 1	72	3	2x2-2LFB30/T8	45	0.14	338	100	3	NO-RETRO	45	0.1	338	2500		1	0	0.0	0	0.00	84	0.00	84
23	2nd fl hall	72	3	2x2-2LFB30/T8	45	0.14	338	100	3	NO-RETRO	45	0.1	338	2500		0	0	0.0	0	0.00	0	0.00	0
24	mens rm	75	5	14W CF/SI	14	0.07	70	100	5	NO-RETRO	14	0.1	70	1000		0	0	0.0	0	0.00	0	0.00	0
25	womens rm	75	8	14W CF/SI	14	0.11	112	100	8	NO-RETRO	14	0.1	112	1000		0	0	0.0	0	0.00	0	0.00	0
26	large meeting hall	50	72	INCAND-1L/25W	25	1.80	4500	100	72	NO-RETRO	25	1.8	4500	2500		0	0	0.0	0	0.00	0	0.00	0
27	2nd fl rear office 1	2	3	2X4-3LF40/EE/EEM	110	0.33	825	104	3	3LF28/HE/LBF	63	0.2	473	2500		0	0	0.1	353	0.00	0	0.00	353
28	3rd fl rear office 2	2	3	2X4-3LF40/EE/EEM	110	0.33	825	104	3	3LF28/HE/LBF	63	0.2	473	2500		1	0	0.1	353	0.00	118	0.00	471
29	break rm	10	6	4'-WRAP-2LF40/EE/EEM	70	0.42	210	105	6	2LF28/HE/LBF	42	0.3	126	500		1	0	0.2	84	0.00	32	0.00	116
TOTALS			239			11.51	24396.90		239			10.02	20884.90			9	0	2.44	3512.00	0.00	796.50	0.00	4308.50

MATERIAL & LABOR

Town of Concord

Town House

ECM: Lighting Improvements

MATERIAL AND LABOR BREAKDOWN

REPLACEMENT MATERIAL	QUANTITY	MATERIAL COST	LABOR COST	TOTAL MATERIAL	TOTAL LABOR	TOTAL RAW COST
NO-RETRO	203	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	4	\$0.00	\$0.00	\$0.00	\$0.00	\$0
4LF28/HE/LBF	0	\$26.00	\$35.00	\$0.00	\$0.00	\$0
4LF28/HE/NBF	0	\$26.00	\$35.00	\$0.00	\$0.00	\$0
3LF28/HE/LBF	6	\$24.00	\$35.00	\$144.00	\$210.00	\$354
2LF28/HE/LBF	11	\$22.00	\$35.00	\$242.00	\$385.00	\$627
1LF28/HE/LBF	0	\$20.00	\$35.00	\$0.00	\$0.00	\$0
8'-2LF28/HE/LBF	0	\$22.00	\$35.00	\$0.00	\$0.00	\$0
12'-3LF28/HE/LBF	0	\$28.00	\$40.00	\$0.00	\$0.00	\$0
14'-4LF28/HE/LBF	0	\$30.00	\$50.00	\$0.00	\$0.00	\$0
8'-4LF28/HE/LBF	0	\$30.00	\$35.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
1LF17/HE/LBF	0	\$15.00	\$35.00	\$0.00	\$0.00	\$0
2LF17/HE/LBF	0	\$19.00	\$35.00	\$0.00	\$0.00	\$0
1LF25/HE/LBF	0	\$16.00	\$35.00	\$0.00	\$0.00	\$0
2LF25/HE/LBF	0	\$22.00	\$35.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
2LFB30/HE/LBF	0	\$27.00	\$35.00	\$0.00	\$0.00	\$0
4'-1LF28/HE/NBF/WR/N	0	\$50.00	\$75.00	\$0.00	\$0.00	\$0
8'-2LF28/HE/NBF/WR/N	0	\$70.00	\$75.00	\$0.00	\$0.00	\$0
12'-3LF28/HE/NBF/WR/N	0	\$95.00	\$125.00	\$0.00	\$0.00	\$0
16'-4LF28/HE/NBF/WR/N	0	\$125.00	\$175.00	\$0.00	\$0.00	\$0
4'-2LF28/HE/NBF/WR/N	0	\$60.00	\$75.00	\$0.00	\$0.00	\$0
8'-4LF28/HE/LBF/WR/N	0	\$75.00	\$75.00	\$0.00	\$0.00	\$0
4'-1LF28/HE/NBF/IND/N	0	\$50.00	\$75.00	\$0.00	\$0.00	\$0
8'-2LF28/HE/NBF/IND/N	0	\$75.00	\$75.00	\$0.00	\$0.00	\$0
12'-3LF28/HE/NBF/IND/N	0	\$95.00	\$125.00	\$0.00	\$0.00	\$0
16'-4LF28/HE/NBF/IND/N	0	\$125.00	\$175.00	\$0.00	\$0.00	\$0
4'-2LF28/HE/NBF/IND/N	0	\$60.00	\$75.00	\$0.00	\$0.00	\$0
8'-4LF28/HE/LBF/IND/N	0	\$75.00	\$75.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
4'-1LF28/HE/NBF/ST/N	0	\$45.00	\$75.00	\$0.00	\$0.00	\$0
8'-2LF28/HE/NBF/ST/N	0	\$65.00	\$75.00	\$0.00	\$0.00	\$0
12'-3LF28/HE/NBF/ST/N	0	\$90.00	\$125.00	\$0.00	\$0.00	\$0
16'-4LF28/HE/NBF/WST/N	0	\$120.00	\$175.00	\$0.00	\$0.00	\$0
4'-1LF28/HE/NBF/WWR/N	0	\$70.00	\$75.00	\$0.00	\$0.00	\$0
8'-2LF28/HE/NBF/WWR/N	0	\$90.00	\$75.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
30W CF/SI	0	\$9.00	\$0.00	\$0.00	\$0.00	\$0
14W CF/SI	0	\$9.00	\$10.00	\$0.00	\$0.00	\$0
23W CF/SI	0	\$9.00	\$10.00	\$0.00	\$0.00	\$0
1X4-1LF28/HE/NBF/N	0	\$75.00	\$75.00	\$0.00	\$0.00	\$0
2X4-2LF28/HE/NBF/N	0	\$80.00	\$75.00	\$0.00	\$0.00	\$0
2L-13W CF/HW	0	\$25.00	\$40.00	\$0.00	\$0.00	\$0
1L-13W CF/HW	0	\$22.00	\$40.00	\$0.00	\$0.00	\$0
REMOVE & CAP	0	\$10.00	\$50.00	\$0.00	\$0.00	\$0

MATERIAL & LABOR

**Town of Concord**

**Town House**

**ECM: Lighting Improvements**

**MATERIAL AND LABOR BREAKDOWN**

NEW LED EXIT	0	\$20.00	\$60.00	\$0.00	\$0.00	\$0
1L-13W CF/HW/JAR	0	\$45.00	\$40.00	\$0.00	\$0.00	\$0
175W MH/LB	0	\$175.00	\$200.00	\$0.00	\$0.00	\$0
250W MH/LB	0	\$200.00	\$200.00	\$0.00	\$0.00	\$0
250W MH/HB	0	\$200.00	\$200.00	\$0.00	\$0.00	\$0
400W MH/HB	0	\$275.00	\$200.00	\$0.00	\$0.00	\$0
35W HPS WALL PACK	0	\$95.00	\$125.00	\$0.00	\$0.00	\$0
70W HPS WALL PACK	0	\$95.00	\$125.00	\$0.00	\$0.00	\$0
35W HPS CANOPY	0	\$110.00	\$125.00	\$0.00	\$0.00	\$0
70W HPS CANOPY	0	\$110.00	\$125.00	\$0.00	\$0.00	\$0
35W HPS MINI-FLOOD	0	\$95.00	\$125.00	\$0.00	\$0.00	\$0
70W HPS MINI-FLOOD	2	\$95.00	\$125.00	\$190.00	\$250.00	\$440
150W HPS/FLOOD	0	\$195.00	\$175.00	\$0.00	\$0.00	\$0
250W HPS/FLOOD	0	\$195.00	\$175.00	\$0.00	\$0.00	\$0
400W HPS/FLOOD	0	\$195.00	\$175.00	\$0.00	\$0.00	\$0
100W HPS/LB	0	\$175.00	\$200.00	\$0.00	\$0.00	\$0
150W HPS/LB	0	\$195.00	\$200.00	\$0.00	\$0.00	\$0
4L-T5/HO/N	0	\$225.00	\$250.00	\$0.00	\$0.00	\$0
3L-T5/HO/N	0	\$200.00	\$250.00	\$0.00	\$0.00	\$0
2L-T5/HO/N	0	\$160.00	\$250.00	\$0.00	\$0.00	\$0
4L-T8/HP/N	0	\$130.00	\$150.00	\$0.00	\$0.00	\$0
3L-T8/HP/N	0	\$125.00	\$150.00	\$0.00	\$0.00	\$0
2L-T8/HP/N	0	\$90.00	\$150.00	\$0.00	\$0.00	\$0
1LF59/LBF	0	\$30.00	\$30.00	\$0.00	\$0.00	\$0
2LF59/LBF	13	\$35.00	\$30.00	\$455.00	\$390.00	\$845
2L-T8/HP/N	0	\$90.00	\$150.00	\$0.00	\$0.00	\$0
1LF59/LBF	0	\$30.00	\$30.00	\$0.00	\$0.00	\$0
2LF59/LBF	0	\$35.00	\$30.00	\$0.00	\$0.00	\$0

**TOTALS :** **239** **\$1,031.00** **\$1,235.00** **\$2,266.00**

<b>HAZARDOUS WASTE</b>	<b>\$88.22</b>
<b>LIGHTING RAW COST</b>	<b>\$2,354.22</b>
<b>TOTAL</b>	<b>\$2,354.22</b>

SIMPLE PAYBACK
8.52

<b>OCCUPANCY SENSORS</b>	<b>QUANTITY</b>	<b>MATERIAL COST</b>	<b>LABOR COST</b>	<b>TOTAL MATERIAL</b>	<b>TOTAL LABOR</b>	<b>TOTAL RAW COST</b>
SWITCH MOUNT	9	\$ 50.00	\$ 35.00	\$450.00	\$315.00	\$765.00
CEILING MOUNT	0	\$ 110.00	\$ 150.00	\$0.00	\$0.00	\$0.00

**TOTALS :** **9** **\$450.00** **\$315.00** **\$765.00**

C:\Documents and Settings\Owner\Desktop\Concord New\Concord Lighting Revised\[Town House lighting 2.xls]EXISTING MAT.



## CODES

EXIST CODE	FIXTURE TYPE	WATTS	# OF LAMPS	# OF BALS.	REPL. CODE	PROPOSED FIXTURE	WATTS	MAT. COST	LABOR COST	# OF BALS.	# OF LAMPS
1	2X4-4LF40/EE/EEM	140	4	2	100	NO-RETRO	0	0	0	0	0
2	2X4-3LF40/EE/EEM	110	3	2	101						
3	2X4-2LF40/EE/EEM	70	2	1	102	4LF28/HE/LBF	82	26	35	1	2
4	1X4-2LF40/EE/EEM	70	2	1	103	4LF28/HE/NBF	93	26	35	1	4
5					104	3LF28/HE/LBF	63	24	35	1	3
6	2X2-2LFB40/ES/EEM	70	2	1	105	2LF28/HE/LBF	42	22	35	1	2
7	2X2-4LF20/ES/STD	112	4	2	106	1LF28/HE/LBF	23	20	35	1	1
8					107	8'-2LF28/HE/LBF	42	22	35	1	2
9	4'-WRAP-1LF40/EE/EEM	40	1	1	108	12'-3LF28/HE/LBF	63	28	40	1	3
10	4'-WRAP-2LF40/EE/EEM	70	2	1	109	14'-4LF28/HE/LBF	82	30	50	1	4
11	4'-WRAP-3LF40/EE/EEM	110	3	2	110	8'-4LF28/HE/LBF	82	30	35	1	4
12	4'-WRAP-4LF40/EE/EEM	140	4	2	111						
13	2'-WALL WR-2LF20/EEM/STD	56	2	1	112						
14	4'-WALL WR-1LF40/EE/EEM	40	1	1	113						
15	4'-WALL WR-2LF40/EE/EEM	70	2	1	114						
16	4'-DAMP WR-1LF40/EE/EEM	40	1	1	115	1LF17/HE/LBF	15	15	35	1	1
17	8'-DAMP WR-1LF96/EE/EEM	83	1	1	116	2LF17/HE/LBF	27	19	35	1	2
18	8'-DAMP WR-2LF96/EE/EEM	123	2	1	117	1LF25/HE/LBF	20	16	35	1	1
19	8'-WRAP-4LF40/EE/EEM	140	4	2	118	2LF25/HE/LBF	39	22	35	1	2
20	4'-IND-1LF40/EE/EEM	40	1	1	119						
21	4'-IND-2LF40/EE/EEM	70	2	1	120						
22	4'-IND-3LF40/EE/EEM	110	3	2	121						
23	4'-IND-4LF40/EE/EEM	140	4	2	122	2LFB30/HE/LBF	45	27	35	1	2
24	4'-IND-2LF40/HO/STD	145	2	1	123	4'-1LF28/HE/NBF/WR/N	25	50	75	1	1
25	8'-IND-4LF40/EE/EEM	140	4	2	124	8'-2LF28/HE/NBF/WR/N	47	70	75	1	2
26	8'-IND-2LF96/EE/EEM	123	2	1	125	12'-3LF28/HE/NBF/WR/N	72	95	125	1	3
27	8'-IND-3LF96/EE/EEM	206	3	2	126	16'-4LF28/HE/NBF/WR/N	94	125	175	1	4
28	8'-IND-2LF96/HO/STD	227	2	1	127	4'-2LF28/HE/NBF/WR/N	47	60	75	1	2
29	8'-IND-4LF96/HO/STD	454	4	2	128	8'-4LF28/HE/LBF/WR/N	82	75	75	1	4
30	2'-STR-1LF20/EEM/STD	32	1	1	129	4'-1LF28/HE/NBF/IND/N	25	50	75	1	1
31	3'-STR-1LF30/EEM/STD	46	1	1	130	8'-2LF28/HE/NBF/IND/N	47	75	75	1	2
32	3'-STR-2LF30/EEM/STD	80	2	1	131	12'-3LF28/HE/NBF/IND/N	72	95	125	1	3
33	4'-STR-1LF40/EE/EEM	40	1	1	132	16'-4LF28/HE/NBF/IND/N	94	125	175	1	4
34	4'-STR-2LF40/EE/EEM	70	2	1	133	4'-2LF28/HE/NBF/IND/N	47	60	75	1	2
35	8'-STR-2LF40/EE/EEM	70	2	1	134	8'-4LF28/HE/LBF/IND/N	82	75	75	1	4
36	8'-STR-1LF96/EE/EEM	83	1	1	135						
37	8'-STR-2LF96/EE/EEM	123	2	1	136	4'-1LF28/HE/NBF/ST/N	25	45	75	1	1
38	4'-ICE TRAY-2LF40/EE/EEM	70	2	1	137	8'-2LF28/HE/NBF/ST/N	47	65	75	1	2
39	8'-ICE TRAY-4LF40/EE/EEM	140	4	2	138	12'-3LF28/HE/NBF/ST/N	72	90	125	1	3
40	4'-ICE TRAY-1LF40/EE/EEM	40	1	1	139	16'-4LF28/HE/NBF/WST/N	94	120	175	1	4
41	8'-ICE TRAY-2LF96/EE/EEM	123	2	1	140	4'-1LF28/HE/NBF/WWR/N	25	70	75	1	1
42	8'-ICE TRAY-4LF96/EE/EEM	246	4	2	141	8'-2LF28/HE/NBF/WWR/N	47	90	75	1	2
43	4'-BOX-2LF40/EE/EEM	70	2	1	142						
44	4'-BOX-3LF40/EE/EEM	110	4	2	143	30W CF/SI	30	9		0	1
45					144	14W CF/SI	14	9	10	0	1
46					145	23W CF/SI	23	9	10	0	1
47	INCAND-1L/60W	60	1	0	146	1X4-1LF28/HE/NBF/N	25	75	75	1	1

## CODES

61	150W Metal Halide	190	1	1	160	70W HPS CANOPY	90	110	125	1	1
62	250W Metal Halide	290	1	1	161	35W HPS MINI-FLOOD	50	95	125	1	1
63	400W Metal Halide	455	1	1	162	70W HPS MINI-FLOOD	90	95	125	1	1
64	70W HPS	90	1	1	163	150W HPS/FLOOD	190	195	175	1	1
65	150W HPS	190	1	1	164	250W HPS/FLOOD	295	195	175	1	1
66	250W HPS	290	1	1	165	400W HPS/FLOOD	460	195	175	1	1
67	400W HPS	455	1	1	166	100W HPS/LB	120	175	200	1	1
68					167	150W HPS/LB	190	195	200	1	1
69	2X4-4LF32/T8	120	4	1	168	4L-T5/HO/N	234	225	250	2	4
70	2X4-3LF32/T8	88	3	1	169	3L-T5/HO/N	177	200	250	2	3
71	2X4-2LF32/T8	60	2	1	170	2L-T5/HO/N	117	160	250	1	2
72	2x2-2LFB30/T8	45	2	1	171	4L-T8/HP/N	156	130	150	1	4
73	2LF32/T8	60	2	1	172	3L-T8/HP/N	112	125	150	1	3
74	2L-13W CF	30	2	2	173	2L-T8/HP/N	78	90	150	1	2
75	14W CF/SI	14	1	1	174	1LF59/LBF	57	30	30	1	1
76					175	2LF59/LBF	100	35	30	1	2
77					176						
78					177						

Town of Concord  
Planning/Land Management  
ECM: Lighting Improvements

\$/kWh 0.085  
\$/kW -

Location		Existing Conditions						Retrofit Conditions								Sensors		Retrofit Savings		Sensor Savings		Total Savings	
Item #	Room #	Code	# Of Fxts	Existing Fixture	Watts	kW	kWh	Code	# Of Fxts	Replacement Fixture	Watts	kW	kWh	H (h/yr)	FC	Sw Mt.	Ceil Mt.	kW Saved	kWh Saved	kW Saved	kWh Saved	Demand kW Reduction	kWh/year Saved
1	Basement	64	16	4'-2LF32/ST	60	0.96	480	100	16	NO-RETRO	60	1.0	480	500		0	0	0.0	0	0.00	0	0.00	0
2	Meeting rm 117	73	8	2X4-4LF32/T8	120	0.96	1920	100	8	NO-RETRO	120	1.0	1920	2000		0	1	0.0	0	0.00	480	0.00	480
3	rm 112	74	2	2X4-3LF32/T8	88	0.18	352	100	2	NO-RETRO	88	0.2	352	2000		1	0	0.0	0	0.00	88	0.00	88
4	rm 110	74	5	2X4-3LF32/T8	88	0.44	880	100	5	NO-RETRO	88	0.4	880	2000		0	0	0.0	0	0.00	0	0.00	0
5	Rest rm	72	1	2x2-3LF17/T8	49	0.05	49	100	1	NO-RETRO	49	0.0	49	1000		1	0	0.0	0	0.00	12	0.00	12
6	Lobby	72	6	2x2-3LF17/T8	49	0.29	735	100	6	NO-RETRO	49	0.3	735	2500		0	0	0.0	0	0.00	0	0.00	0
7	Mens rm	72	2	2x2-3LF17/T8	49	0.10	98	100	2	NO-RETRO	49	0.1	98	1000		0	0	0.0	0	0.00	0	0.00	0
8	Womens rm	72	2	2x2-3LF17/T8	49	0.10	98	100	2	NO-RETRO	49	0.1	98	1000		0	0	0.0	0	0.00	0	0.00	0
9	rm 102	74	2	2X4-3LF32/T8	88	0.18	352	100	2	NO-RETRO	88	0.2	352	2000		1	0	0.0	0	0.00	88	0.00	88
10	rm 101	74	4	2X4-3LF32/T8	88	0.35	704	100	4	NO-RETRO	88	0.4	704	2000		1	0	0.0	0	0.00	176	0.00	176
11	rm 103	74	9	2X4-3LF32/T8	88	0.79	1584	100	9	NO-RETRO	88	0.8	1584	2000		0	0	0.0	0	0.00	0	0.00	0
12	2nd fl main office	74	16	2X4-3LF32/T8	88	1.41	3520	100	16	NO-RETRO	88	1.4	3520	2500		0	0	0.0	0	0.00	0	0.00	0
13	2nd fl main office	72	2	2x2-3LF17/T8	49	0.10	245	100	2	NO-RETRO	49	0.1	245	2500		0	0	0.0	0	0.00	0	0.00	0
14	rm 210	74	2	2X4-3LF32/T8	88	0.18	352	100	2	NO-RETRO	88	0.2	352	2000		1	0	0.0	0	0.00	88	0.00	88
15	rm 216	74	2	2X4-3LF32/T8	88	0.18	352	100	2	NO-RETRO	88	0.2	352	2000		1	0	0.0	0	0.00	88	0.00	88
16	rm 215	74	2	2X4-3LF32/T8	88	0.18	352	100	2	NO-RETRO	88	0.2	352	2000		1	0	0.0	0	0.00	88	0.00	88
17	rm 214	63	3	4'-2LF32/WR	60	0.18	360	100	3	NO-RETRO	60	0.2	360	2000		1	0	0.0	0	0.00	90	0.00	90
18	Hall	72	5	2x2-3LF17/T8	49	0.25	613	100	5	NO-RETRO	49	0.2	613	2500		0	0	0.0	0	0.00	0	0.00	0
19	2nd fl Mens rm	72	2	2x2-3LF17/T8	49	0.10	98	100	2	NO-RETRO	49	0.1	98	1000		0	0	0.0	0	0.00	0	0.00	0
20	2nd fl Womens rm	72	2	2x2-3LF17/T8	49	0.10	98	100	2	NO-RETRO	49	0.1	98	1000		0	0	0.0	0	0.00	0	0.00	0
21	Janitor rm 202	64	1	4'-2LF32/ST	60	0.06	30	100	1	NO-RETRO	60	0.1	30	500		1	0	0.0	0	0.00	8	0.00	8
22	2nd fl Lunch rm	73	2	2X4-4LF32/T8	120	0.24	120	100	2	NO-RETRO	120	0.2	120	500		1	0	0.0	0	0.00	30	0.00	30
23	2nd fl Confrence rm	74	6	2X4-3LF32/T8	88	0.53	264	100	6	NO-RETRO	88	0.5	264	500		0	1	0.0	0	0.00	66	0.00	66
24	Storage 205	74	2	2X4-3LF32/T8	88	0.18	176	100	2	NO-RETRO	88	0.2	176	1000		1	0	0.0	0	0.00	44	0.00	44
25	Stairs	76	2	1X4-2LF32/T8	60	0.12	300	100	2	NO-RETRO	60	0.1	300	2500		0	0	0.0	0	0.00	0	0.00	0
26				0	0	0.00	0		0	0	0.0	0	0	2500		0	0	0.0	0	0.00	0	0.00	0
TOTALS		106				8.17	14131.50	106				8.17	14131.50			11	2	0.00	0.00	0.00	1345.75	0.00	1345.75

MATERIAL & LABOR

**Town of Concord**  
**Planning/Land Management**  
**ECM: Lighting Improvements**  
MATERIAL AND LABOR BREAKDOWN

REPLACEMENT MATERIAL	QUANTITY	MATERIAL COST	LABOR COST	TOTAL MATERIAL	TOTAL LABOR	TOTAL RAW COST
NO-RETRO	106	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
4LF28/HE/LBF	0	\$26.00	\$35.00	\$0.00	\$0.00	\$0
4LF28/HE/NBF	0	\$26.00	\$35.00	\$0.00	\$0.00	\$0
3LF28/HE/LBF	0	\$24.00	\$35.00	\$0.00	\$0.00	\$0
2LF28/HE/LBF	0	\$22.00	\$35.00	\$0.00	\$0.00	\$0
1LF28/HE/LBF	0	\$20.00	\$35.00	\$0.00	\$0.00	\$0
8'-2LF28/HE/LBF	0	\$22.00	\$35.00	\$0.00	\$0.00	\$0
12'-3LF28/HE/LBF	0	\$28.00	\$40.00	\$0.00	\$0.00	\$0
14'-4LF28/HE/LBF	0	\$30.00	\$50.00	\$0.00	\$0.00	\$0
8'-4LF28/HE/LBF	0	\$30.00	\$35.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
1LF17/HE/LBF	0	\$15.00	\$35.00	\$0.00	\$0.00	\$0
2LF17/HE/LBF	0	\$19.00	\$35.00	\$0.00	\$0.00	\$0
1LF25/HE/LBF	0	\$16.00	\$35.00	\$0.00	\$0.00	\$0
2LF25/HE/LBF	0	\$22.00	\$35.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
2LFB30/HE/LBF	0	\$27.00	\$35.00	\$0.00	\$0.00	\$0
4'-1LF28/HE/NBF/WR/N	0	\$50.00	\$75.00	\$0.00	\$0.00	\$0
8'-2LF28/HE/NBF/WR/N	0	\$70.00	\$75.00	\$0.00	\$0.00	\$0
12'-3LF28/HE/NBF/WR/N	0	\$95.00	\$125.00	\$0.00	\$0.00	\$0
16'-4LF28/HE/NBF/WR/N	0	\$125.00	\$175.00	\$0.00	\$0.00	\$0
4'-2LF28/HE/NBF/WR/N	0	\$60.00	\$75.00	\$0.00	\$0.00	\$0
8'-4LF28/HE/LBF/WR/N	0	\$75.00	\$75.00	\$0.00	\$0.00	\$0
4'-1LF28/HE/NBF/IND/N	0	\$50.00	\$75.00	\$0.00	\$0.00	\$0
8'-2LF28/HE/NBF/IND/N	0	\$75.00	\$75.00	\$0.00	\$0.00	\$0
12'-3LF28/HE/NBF/IND/N	0	\$95.00	\$125.00	\$0.00	\$0.00	\$0
16'-4LF28/HE/NBF/IND/N	0	\$125.00	\$175.00	\$0.00	\$0.00	\$0
4'-2LF28/HE/NBF/IND/N	0	\$60.00	\$75.00	\$0.00	\$0.00	\$0
8'-4LF28/HE/LBF/IND/N	0	\$75.00	\$75.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
4'-1LF28/HE/NBF/ST/N	0	\$45.00	\$75.00	\$0.00	\$0.00	\$0
8'-2LF28/HE/NBF/ST/N	0	\$65.00	\$75.00	\$0.00	\$0.00	\$0
12'-3LF28/HE/NBF/ST/N	0	\$90.00	\$125.00	\$0.00	\$0.00	\$0
16'-4LF28/HE/NBF/WST/N	0	\$120.00	\$175.00	\$0.00	\$0.00	\$0
4'-1LF28/HE/NBF/WWR/N	0	\$70.00	\$75.00	\$0.00	\$0.00	\$0
8'-2LF28/HE/NBF/WWR/N	0	\$90.00	\$75.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
15W CF/SI	0	\$9.00	\$10.00	\$0.00	\$0.00	\$0
23W CF/SI	0	\$9.00	\$10.00	\$0.00	\$0.00	\$0
1X4-1LF28/HE/NBF/N	0	\$75.00	\$75.00	\$0.00	\$0.00	\$0
2X4-2LF28/HE/NBF/N	0	\$80.00	\$75.00	\$0.00	\$0.00	\$0
2L-13W CF/HW	0	\$25.00	\$40.00	\$0.00	\$0.00	\$0
1L-13W CF/HW	0	\$22.00	\$40.00	\$0.00	\$0.00	\$0
REMOVE & CAP	0	\$10.00	\$50.00	\$0.00	\$0.00	\$0

MATERIAL & LABOR

**Town of Concord  
Planning/Land Management  
ECM: Lighting Improvements**

**MATERIAL AND LABOR BREAKDOWN**

NEW LED EXIT	0	\$20.00	\$60.00	\$0.00	\$0.00	\$0
1L-13W CF/HW/JAR	0	\$45.00	\$40.00	\$0.00	\$0.00	\$0
175W MH/LB	0	\$175.00	\$200.00	\$0.00	\$0.00	\$0
250W MH/LB	0	\$200.00	\$200.00	\$0.00	\$0.00	\$0
250W MH/HB	0	\$200.00	\$200.00	\$0.00	\$0.00	\$0
400W MH/HB	0	\$275.00	\$200.00	\$0.00	\$0.00	\$0
35W HPS WALL PACK	0	\$95.00	\$125.00	\$0.00	\$0.00	\$0
70W HPS WALL PACK	0	\$95.00	\$125.00	\$0.00	\$0.00	\$0
35W HPS CANOPY	0	\$110.00	\$125.00	\$0.00	\$0.00	\$0
70W HPS CANOPY	0	\$110.00	\$125.00	\$0.00	\$0.00	\$0
35W HPS MINI-FLOOD	0	\$95.00	\$125.00	\$0.00	\$0.00	\$0
70W HPS MINI-FLOOD	0	\$95.00	\$125.00	\$0.00	\$0.00	\$0
150W HPS/FLOOD	0	\$195.00	\$175.00	\$0.00	\$0.00	\$0
250W HPS/FLOOD	0	\$195.00	\$175.00	\$0.00	\$0.00	\$0
400W HPS/FLOOD	0	\$195.00	\$175.00	\$0.00	\$0.00	\$0
100W HPS/LB	0	\$175.00	\$200.00	\$0.00	\$0.00	\$0
150W HPS/LB	0	\$195.00	\$200.00	\$0.00	\$0.00	\$0
4L-T5/HO/N	0	\$200.00	\$250.00	\$0.00	\$0.00	\$0
3L-T5/HO/N	0	\$175.00	\$250.00	\$0.00	\$0.00	\$0
2L-T5/HO/N	0	\$135.00	\$250.00	\$0.00	\$0.00	\$0
4L-T8/HP/N	0	\$130.00	\$150.00	\$0.00	\$0.00	\$0
3L-T8/HP/N	0	\$125.00	\$150.00	\$0.00	\$0.00	\$0
2L-T8/HP/N	0	\$90.00	\$150.00	\$0.00	\$0.00	\$0
1LF59/LBF	0	\$30.00	\$30.00	\$0.00	\$0.00	\$0
2LF59/LBF	0	\$35.00	\$30.00	\$0.00	\$0.00	\$0

**TOTALS :** **106** **\$0.00** **\$0.00** **\$0.00**

<b>HAZARDOUS WASTE</b>	<b>\$0.00</b>
<b>LIGHTING RAW COST TOTAL</b>	<b>\$0.00</b>

SIMPLE PAYBACK
12.72

<b>OCCUPANCY SENSORS</b>	<b>QUANTITY</b>	<b>MATERIAL COST</b>	<b>LABOR COST</b>	<b>TOTAL MATERIAL</b>	<b>TOTAL LABOR</b>	<b>TOTAL RAW COST</b>
SWITCH MOUNT	11	\$ 50.00	\$ 35.00	\$550.00	\$385.00	\$935.00
CEILING MOUNT	2	\$ 110.00	\$ 150.00	\$220.00	\$300.00	\$520.00

**TOTALS :** **13** **\$770.00** **\$685.00** **\$1,455.00**





## CODES

EXIST CODE	FIXTURE TYPE	WATTS	# OF LAMPS	# OF BALS.	REPL. CODE	PROPOSED FIXTURE	WATTS	MAT. COST	LABOR COST	# OF BALS.	# OF LAMPS
1	2X4-ACRY-4LF40/EE/EEM	140	4	2	100	NO-RETRO	0	0	0	0	0
2	2X4-ACRY-3LF40/EE/EEM	110	3	2	101						
3	2X4-ACRY-2LF40/EE/EEM	70	2	1	102	4LF28/HE/LBF	82	26	35	1	2
4	2X4-PARA-4LF40/EE/EEM	140	4	2	103	4LF28/HE/NBF	93	26	35	1	4
5	2X4-PARA-3LF40/EE/EEM	110	3	2	104	3LF28/HE/LBF	63	24	35	1	3
6	2X4-PARA-2LF40/EE/EEM	70	2	1	105	2LF28/HE/LBF	42	22	35	1	2
7	1X4-PARA-2LF40/EE/EEM	70	2	1	106	1LF28/HE/LBF	23	20	35	1	1
8	1X4-ACRY-2LF40/EE/EEM	70	2	1	107	8'-2LF28/HE/LBF	42	22	35	1	2
9	2X2-PARA-2LFB40/ES/EEM	70	2	1	108	12'-3LF28/HE/LBF	63	28	40	1	3
10	2X2-ACRY-2LFB40/ES/EEM	70	2	1	109	14'-4LF28/HE/LBF	82	30	50	1	4
11	2X2-ACRY-4LF20/ES/STD	112	4	2	110	8'-4LF28/HE/LBF	82	30	35	1	4
12	4'-WRAP-1LF40/EE/EEM	40	1	1	111						
13	4'-WRAP-2LF40/EE/EEM	70	2	1	112						
14	4'-WRAP-3LF40/EE/EEM	110	3	2	113						
15	4'-WRAP-4LF40/EE/EEM	140	4	2	114						
16	2'-WALL WR-2LF20/EEM/STD	56	2	1	115	1LF17/HE/LBF	15	15	35	1	1
17	4'-WALL WR-1LF40/EE/EEM	40	1	1	116	2LF17/HE/LBF	27	19	35	1	2
18	4'-WALL WR-2LF40/EE/EEM	70	2	1	117	1LF25/HE/LBF	20	16	35	1	1
19	4'-DAMP WR-1LF40/EE/EEM	40	1	1	118	2LF25/HE/LBF	39	22	35	1	2
20	8'-DAMP WR-1LF96/EE/EEM	83	1	1	119						
21	8'-DAMP WR-2LF96/EE/EEM	123	2	1	120						
22	8'-WRAP-4LF40/EE/EEM	140	4	2	121						
23	4'-IND-1LF40/EE/EEM	40	1	1	122	2LFB30/HE/LBF	45	27	35	1	2
24	4'-IND-2LF40/EE/EEM	70	2	1	123	4'-1LF28/HE/NBF/WR/N	25	50	75	1	1
25	4'-IND-3LF40/EE/EEM	110	3	2	124	8'-2LF28/HE/NBF/WR/N	47	70	75	1	2
26	4'-IND-4LF40/EE/EEM	140	4	2	125	12'-3LF28/HE/NBF/WR/N	72	95	125	1	3
27	4'-IND-2LF40/HO/STD	145	2	1	126	16'-4LF28/HE/NBF/WR/N	94	125	175	1	4
28	8'-IND-4LF40/EE/EEM	140	4	2	127	4'-2LF28/HE/NBF/WR/N	47	60	75	1	2
29	8'-IND-2LF96/EE/EEM	123	2	1	128	8'-4LF28/HE/LBF/WR/N	82	75	75	1	4
30	8'-IND-3LF96/EE/EEM	206	3	2	129	4'-1LF28/HE/NBF/IND/N	25	50	75	1	1
31	8'-IND-2LF96/HO/STD	227	2	1	130	8'-2LF28/HE/NBF/IND/N	47	75	75	1	2
32	8'-IND-4LF96/HO/STD	454	4	2	131	12'-3LF28/HE/NBF/IND/N	72	95	125	1	3
33	2'-STR-1LF20/EEM/STD	32	1	1	132	16'-4LF28/HE/NBF/IND/N	94	125	175	1	4
34	3'-STR-1LF30/EEM/STD	46	1	1	133	4'-2LF28/HE/NBF/IND/N	47	60	75	1	2
35	3'-STR-2LF30/EEM/STD	80	2	1	134	8'-4LF28/HE/LBF/IND/N	82	75	75	1	4
36	4'-STR-1LF40/EE/EEM	40	1	1	135						
37	4'-STR-2LF40/EE/EEM	70	2	1	136	4'-1LF28/HE/NBF/ST/N	25	45	75	1	1
38	8'-STR-2LF40/EE/EEM	70	2	1	137	8'-2LF28/HE/NBF/ST/N	47	65	75	1	2
39	8'-STR-1LF96/EE/EEM	83	1	1	138	12'-3LF28/HE/NBF/ST/N	72	90	125	1	3
40	8'-STR-2LF96/EE/EEM	123	2	1	139	16'-4LF28/HE/NBF/WST/N	94	120	175	1	4
41	4'-ICE TRAY-2LF40/EE/EEM	70	2	1	140	4'-1LF28/HE/NBF/WWR/N	25	70	75	1	1
42	8'-ICE TRAY-4LF40/EE/EEM	140	4	2	141	8'-2LF28/HE/NBF/WWR/N	47	90	75	1	2
43	4'-ICE TRAY-4LF40/EE/EEM	140	4	2	142						
44	8'-ICE TRAY-2LF96/EE/EEM	123	2	1	143						
45	8'-ICE TRAY-4LF96/EE/EEM	246	4	2	144	15W CF/SI	15	9	10	0	1
46	4'-BOX-2LF40/EE/EEM	70	2	1	145	23W CF/SI	23	9	10	0	1
47	4'-BOX-3LF40/EE/EEM	110	4	2	146	1X4-1LF28/HE/NBF/N	25	75	75	1	1

## CODES

[illegible]

Town of Concord  
Public Safety Complex  
ECM: Lighting Improvements

\$/kWh 0.085  
\$/kW -

Location		Existing Conditions						Retrofit Conditions								Sensors		Retrofit Savings		Sensor Savings		Total Savings	
Item #	Room #	Code	# Of Fxts	Existing Fixture	Watts	kW	kWh	Code	# Of Fxts	Replacement Fixture	Watts	kW	kWh	H (h/yr)	FC	Sw Mt.	Ceil Mt.	kW Saved	kWh Saved	kW Saved	kWh Saved	Demand kW Reduction	kWh/year Saved
1	3rd fl attic storage	77	13	2LF32/T8	60	0.78	780	100	13	NO-RETRO	60	0.8	780	1000		0	0	0.0	0	0.00	0	0.00	0
2	3rd fl computer rm	72	3	2x2-2LFB30/T8	45	0.14	135	100	3	NO-RETRO	45	0.1	135	1000		1	0	0.0	0	0.00	34	0.00	34
3	3rd fl restroom hall	72	5	2x2-2LFB30/T8	45	0.23	563	100	5	NO-RETRO	45	0.2	563	2500		0	0	0.0	0	0.00	0	0.00	0
4	3rd fl kitchen	72	4	2x2-2LFB30/T8	45	0.18	180	100	4	NO-RETRO	45	0.2	180	1000		0	0	0.0	0	0.00	0	0.00	0
5	3rd fl kitchen hall	72	3	2x2-2LFB30/T8	45	0.14	338	100	3	NO-RETRO	45	0.1	338	2500		0	0	0.0	0	0.00	0	0.00	0
6	3rd fl men's rm	77	1	2LF32/T8	60	0.06	60	100	1	NO-RETRO	60	0.1	60	1000		0	0	0.0	0	0.00	0	0.00	0
7	3rd fl rear hall	72	4	2x2-2LFB30/T8	45	0.18	450	100	4	NO-RETRO	45	0.2	450	2500		0	0	0.0	0	0.00	0	0.00	0
8	3rd fl stairwell	48	2	INCAND-1L/60W	60	0.12	300	144	2	14W CF/SI	14	0.0	70	2500		0	0	0.1	230	0.00	0	0.00	230
9	3rd fl training rm	51	15	INCAND-1L/150W	150	2.25	2250	100	15	NO-RETRO	150	2.3	2250	1000		0	0	0.0	0	0.00	0	0.00	0
10	3rd fl training rm	72	15	2x2-2LFB30/T8	45	0.68	675	100	15	NO-RETRO	45	0.7	675	1000		0	0	0.0	0	0.00	0	0.00	0
11	3rd fl women's rm	77	1	2LF32/T8	60	0.06	60	100	1	NO-RETRO	60	0.1	60	1000		0	0	0.0	0	0.00	0	0.00	0
12	2nd fl admin area	72	5	2x2-2LFB30/T8	45	0.23	563	100	5	NO-RETRO	45	0.2	563	2500		0	0	0.0	0	0.00	0	0.00	0
13	2nd fl CID file rm	1	15	2X4-ACRY-4LF40/EE/EEM	140	2.10	5250	103	15	4LF28/HE/NBF	93	1.4	3488	2500		0	0	0.7	1763	0.00	0	0.00	1763
14	2nd fl detective office	1	2	2X4-ACRY-4LF40/EE/EEM	140	0.28	700	103	2	4LF28/HE/NBF	93	0.2	465	2500		1	0	0.1	235	0.00	116	0.00	351
15	2nd fl DVVAP	72	4	2x2-2LFB30/T8	45	0.18	450	100	4	NO-RETRO	45	0.2	450	2500		1	0	0.0	0	0.00	113	0.00	113
16	2nd fl CID hall	72	14	2x2-2LFB30/T8	45	0.63	1575	100	14	NO-RETRO	45	0.6	1575	2500		0	0	0.0	0	0.00	0	0.00	0
17	2nd fl Macone office	72	6	2x2-2LFB30/T8	45	0.27	675	100	6	NO-RETRO	45	0.3	675	2500		1	0	0.0	0	0.00	169	0.00	169
18	2nd fl men's lockers	72	14	2x2-2LFB30/T8	45	0.63	1575	100	14	NO-RETRO	45	0.6	1575	2500		0	0	0.0	0	0.00	0	0.00	0
19	2nd fl patrol office	72	4	2x2-2LFB30/T8	45	0.18	450	100	4	NO-RETRO	45	0.2	450	2500		1	0	0.0	0	0.00	113	0.00	113
20	2nd fl police chief	72	8	2x2-2LFB30/T8	45	0.36	900	100	8	NO-RETRO	45	0.4	900	2500		1	0	0.0	0	0.00	225	0.00	225
21	2nd fl conference rm	73	4	2X4-4LF32/T8	120	0.48	240	100	4	NO-RETRO	120	0.5	240	500		1	0	0.0	0	0.00	60	0.00	60
22	2nd fl fax area	73	2	2X4-4LF32/T8	120	0.24	600	100	2	NO-RETRO	120	0.2	600	2500		0	0	0.0	0	0.00	0	0.00	0
23	2nd fl fax area	72	4	2x2-2LFB30/T8	45	0.18	450	100	4	NO-RETRO	45	0.2	450	2500		0	0	0.0	0	0.00	0	0.00	0
24	2nd fl janitor closet	48	1	INCAND-1L/60W	60	0.06	30	144	1	14W CF/SI	14	0.0	7	500		0	0	0.0	23	0.00	0	0.00	23
25	2nd fl safety officer	73	2	2X4-4LF32/T8	120	0.24	600	100	2	NO-RETRO	120	0.2	600	2500		1	0	0.0	0	0.00	150	0.00	150
26	2nd fl women's lockers	75	3	2X4-2LF32/T8	60	0.18	180	100	3	NO-RETRO	60	0.2	180	1000		0	0	0.0	0	0.00	0	0.00	0
27	police front entry	50	1	INCAND-1L/90W	90	0.09	788	144	1	14W CF/SI	14	0.0	123	8760		0	0	0.1	666	0.00	0	0.00	666
28	police front lobby	72	4	2x2-2LFB30/T8	45	0.18	450	100	4	NO-RETRO	45	0.2	450	2500		0	0	0.0	0	0.00	0	0.00	0
29	police lobby restroom	50	2	INCAND-1L/90W	90	0.18	180	144	2	14W CF/SI	14	0.0	28	1000		0	0	0.2	152	0.00	0	0.00	152
30	Gear rm	13	4	4'-WRAP-2LF40/EE/EEM	70	0.28	700	105	4	2LF28/HE/LBF	42	0.2	420	2500		0	0	0.1	280	0.00	0	0.00	280
31	Gear rm	48	1	INCAND-1L/60W	60	0.06	150	144	1	14W CF/SI	14	0.0	35	2500		0	0	0.0	115	0.00	0	0.00	115
32	Generator rm	77	2	2LF32/T8	60	0.12	60	100	2	NO-RETRO	60	0.1	60	500		0	0	0.0	0	0.00	0	0.00	0
33	elevator	77	1	2LF32/T8	60	0.06	150	100	1	NO-RETRO	60	0.1	150	2500		0	0	0.0	0	0.00	0	0.00	0
34	tele/com rm-1	50	1	INCAND-1L/90W	90	0.09	788	144	1	14W CF/SI	14	0.0	123	8760		0	0	0.1	666	0.00	0	0.00	666
35	tele/com rm-2	1	2	2X4-ACRY-4LF40/EE/EEM	140	0.28	2453	103	2	4LF28/HE/NBF	93	0.2	1629	8760		1	0	0.1	823	0.00	407	0.00	1231

Location		Existing Conditions						Retrofit Conditions								Sensors		Retrofit Savings		Sensor Savings		Total Savings	
Item #	Room #	Code	# Of Fxts	Existing Fixture	Watts	kW	kWh	Code	# Of Fxts	Replacement Fixture	Watts	kW	kWh	H (h/yr)	FC	Sw Mt.	Cell Mt.	kW Saved	kWh Saved	kW Saved	kWh Saved	Demand kW Reduction	kWh/year Saved
36	police admin area	1	4	2X4-ACRY-4LF40/EE/EEM	140	0.56	1400	103	4	4LF28/HE/NBF	93	0.4	930	2500		0	0	0.2	470	0.00	0	0.00	470
37	police supply closet	13	1	4"-WRAP-2LF40/EE/EEM	70	0.07	35	105	1	2LF28/HE/LBF	42	0.0	21	500		0	0	0.0	14	0.00	0	0.00	14
38	police alarm rm	73	2	2X4-4LF32/T8	120	0.24	2102	103	2	4LF28/HE/NBF	93	0.2	1629	8760		0	0	0.1	473	0.00	0	0.00	473
39	police booking rm	74	4	2X4-3LF32/T8	88	0.35	880	100	4	NO-RETRO	88	0.4	880	2500		0	0	0.0	0	0.00	0	0.00	0
40	police computer rm	1	1	2X4-ACRY-4LF40/EE/EEM	140	0.14	350	103	1	4LF28/HE/NBF	93	0.1	233	2500		0	0	0.0	118	0.00	0	0.00	118
41	police janitor's closet	50	1	INCAND-1L/90W	90	0.09	45	144	1	14W CF/SI	14	0.0	7	500		0	0	0.1	38	0.00	0	0.00	38
42	police dispatch	72	10	2x2-2LFB30/T8	45	0.45	1125	100	10	NO-RETRO	45	0.5	1125	2500		0	0	0.0	0	0.00	0	0.00	0
43	police dispatch hall	72	2	2x2-2LFB30/T8	45	0.09	225	100	2	NO-RETRO	45	0.1	225	2500		0	0	0.0	0	0.00	0	0.00	0
44	police dispatch restroom	48	2	INCAND-1L/60W	60	0.12	120	144	2	14W CF/SI	14	0.0	28	1000		0	0	0.1	92	0.00	0	0.00	92
45	police dispatch super	74	2	2X4-3LF32/T8	88	0.18	440	100	2	NO-RETRO	88	0.2	440	2500		0	0	0.0	0	0.00	0	0.00	0
46	police juvenile hall	74	1	2X4-3LF32/T8	88	0.09	220	100	1	NO-RETRO	88	0.1	220	2500		0	0	0.0	0	0.00	0	0.00	0
47	police juvenile holding	77	1	2LF32/T8	60	0.06	150	100	1	NO-RETRO	60	0.1	150	2500		0	0	0.0	0	0.00	0	0.00	0
48	police cells	77	3	2LF32/T8	60	0.18	450	100	3	NO-RETRO	60	0.2	450	2500		0	0	0.0	0	0.00	0	0.00	0
49	police cells hall	77	1	2LF32/T8	60	0.06	150	100	1	NO-RETRO	60	0.1	150	2500		0	0	0.0	0	0.00	0	0.00	0
50	police mail rm	72	2	2x2-2LFB30/T8	45	0.09	225	100	2	NO-RETRO	45	0.1	225	2500		0	0	0.0	0	0.00	0	0.00	0
51	police men's lockers	1	6	2X4-ACRY-4LF40/EE/EEM	140	0.84	840	103	6	4LF28/HE/NBF	93	0.6	558	1000		0	0	0.3	282	0.00	0	0.00	282
52	police sally port	77	6	2LF32/T8	60	0.36	900	100	6	NO-RETRO	60	0.4	900	2500		0	0	0.0	0	0.00	0	0.00	0
53	police sm office	74	4	2X4-3LF32/T8	88	0.35	880	100	4	NO-RETRO	88	0.4	880	2500		0	0	0.0	0	0.00	0	0.00	0
54	police squad rm	77	5	2LF32/T8	60	0.30	750	100	5	NO-RETRO	60	0.3	750	2500		0	0	0.0	0	0.00	0	0.00	0
55	police staff rm	1	4	2X4-ACRY-4LF40/EE/EEM	140	0.56	1400	103	4	4LF28/HE/NBF	93	0.4	930	2500		0	0	0.2	470	0.00	0	0.00	470
56	gym	13	12	4"-WRAP-2LF40/EE/EEM	70	0.84	2100	105	12	2LF28/HE/LBF	42	0.5	1260	2500		0	0	0.3	840	0.00	0	0.00	840
57	fire main entry	72	2	2x2-2LFB30/T8	45	0.09	225	100	2	NO-RETRO	45	0.1	225	2500		0	0	0.0	0	0.00	0	0.00	0
58	fire truck bay	77	60	2LF32/T8	60	3.60	9000	100	60	NO-RETRO	60	3.6	9000	2500		0	0	0.0	0	0.00	0	0.00	0
59	fire 2nd fl hall	72	6	2x2-2LFB30/T8	45	0.27	675	100	6	NO-RETRO	45	0.3	675	2500		0	0	0.0	0	0.00	0	0.00	0
60	fire 2nd fl Stairwell	11	1	2X2-ACRY-4LF20/ES/STD	112	0.11	981	116	1	2LF17/HE/LBF	27	0.0	237	8760		0	0	0.1	745	0.00	0	0.00	745
61	fire 2nd fl supply rm	1	1	2X4-ACRY-4LF40/EE/EEM	140	0.14	70	103	1	4LF28/HE/NBF	93	0.1	47	500		0	0	0.0	24	0.00	0	0.00	24
62	fire 3rd fl Stairwell	11	1	2X2-ACRY-4LF20/ES/STD	112	0.11	981	116	1	2LF17/HE/LBF	27	0.0	237	8760		0	0	0.1	745	0.00	0	0.00	745
63	fire restroom	72	1	2x2-2LFB30/T8	45	0.05	45	100	1	NO-RETRO	45	0.0	45	1000		0	0	0.0	0	0.00	0	0.00	0
64	fire sleeping rm	1	7	2X4-ACRY-4LF40/EE/EEM	140	0.98	980	103	7	4LF28/HE/NBF	93	0.7	651	1000		0	0	0.3	329	0.00	0	0.00	329
65	fire captain's office	1	3	2X4-ACRY-4LF40/EE/EEM	140	0.42	1050	103	3	4LF28/HE/NBF	93	0.3	698	2500		1	0	0.1	353	0.00	174	0.00	527
66	fire admin area	1	4	2X4-ACRY-4LF40/EE/EEM	140	0.56	1400	103	4	4LF28/HE/NBF	93	0.4	930	2500		0	0	0.2	470	0.00	0	0.00	470
67	fire chief's office	1	8	2X4-ACRY-4LF40/EE/EEM	140	1.12	2800	103	8	4LF28/HE/NBF	93	0.7	1860	2500		1	0	0.4	940	0.00	465	0.00	1405
68	fire deputy chief's office	72	4	2x2-2LFB30/T8	45	0.18	450	100	4	NO-RETRO	45	0.2	450	2500		1	0	0.0	0	0.00	113	0.00	113
69	fire dispatch	1	2	2X4-ACRY-4LF40/EE/EEM	140	0.28	2453	103	2	4LF28/HE/NBF	93	0.2	1629	8760		0	0	0.1	823	0.00	0	0.00	823
70	fire investigation	1	4	2X4-ACRY-4LF40/EE/EEM	140	0.56	1400	103	4	4LF28/HE/NBF	93	0.4	930	2500		1	0	0.2	470	0.00	233	0.00	703
71	fire kitchen	1	7	2X4-ACRY-4LF40/EE/EEM	140	0.98	980	103	7	4LF28/HE/NBF	93	0.7	651	1000		0	0	0.3	329	0.00	0	0.00	329
72	fire lower hall	72	1	2x2-2LFB30/T8	45	0.05	113	100	1	NO-RETRO	45	0.0	113	2500		0	0	0.0	0	0.00	0	0.00	0
73	fire lower hall	1	1	2X4-ACRY-4LF40/EE/EEM	140	0.14	1226	103	1	4LF28/HE/NBF	93	0.1	815	8760		0	0	0.0	412	0.00	0	0.00	412



Location		Existing Conditions						Retrofit Conditions								Sensors		Retrofit Savings		Sensor Savings		Total Savings							
Item #	Room #	Code	# Of Fxts	Existing Fixture	Watts	kW	kWh	Code	# Of Fxts	Replacement Fixture	Watts	kW	kWh	H (h/yr)	FC	Sw Mt.	Ceil Mt.	kW Saved	kWh Saved	kW Saved	kWh Saved	Demand kW Reduction	kWh/year Saved						
74	fire medical rm	13	1	4'-WRAP-2LF40/EE/EEM	70	0.07	175	105	1	2LF28/HE/LBF	42	0.0	105	2500		1	0	0.0	70	0.00	26	0.00	96						
75	fire laundry	72	4	2x2-2LFB30/T8	45	0.18	180	100	4	NO-RETRO	45	0.2	180	1000		0	0	0.0	0	0.00	0	0.00	0						
76	ait compressor rm	13	1	4'-WRAP-2LF40/EE/EEM	70	0.07	35	105	1	2LF28/HE/LBF	42	0.0	21	500		0	0	0.0	14	0.00	0	0.00	14						
77	exterior	76	6	70W HPS	90	0.54	2160	100	6	NO-RETRO	90	0.5	2160	4000		0	0	0.0	0	0.00	0	0.00	0						
78	exterior	48	6	INCAND-1L/60W	60	0.36	1440	144	6	14W CF/SI	14	0.1	336	4000		0	0	0.3	1104	0.00	0	0.00	1104						
79	exterior	65	2	QUARTZ-1L/300W	300	0.60	2400	162	2	70W HPS MINI-FLOOD	90	0.2	720	4000		0	0	0.4	1680	0.00	0	0.00	1680						
80	exterior	67	3	Metal Halide-1L/150W	190	0.57	2280	100	3	NO-RETRO	190	0.6	2280	4000		0	0	0.0	0	0.00	0	0.00	0						
81	exterior	78	5	150W HPS	190	0.95	3800	100	5	NO-RETRO	190	1.0	3800	4000		0	0	0.0	0	0.00	0	0.00	0						
82	exterior	79	6	400W HPS	455	2.73	10920	100	6	NO-RETRO	455	2.7	10920	4000		0	0	0.0	0	0.00	0	0.00	0						
83				0	0	0.00	0		0	0	#N/A	0.0	0	2500		0	0	0.0	0	0.00	0	0.00	0						
TOTALS		393		34.10		88753.44		393		28.65		72498.08		14		0		5.45		16255.36		0.00		2396.72		0.00		18652.08	

MATERIAL & LABOR

**Town of Concord**  
**Public Safety Complex**  
**ECM: Lighting Improvements**  
MATERIAL AND LABOR BREAKDOWN

REPLACEMENT MATERIAL	QUANTITY	MATERIAL COST	LABOR COST	TOTAL MATERIAL	TOTAL LABOR	TOTAL RAW COST
NO-RETRO	280	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
4LF28/HE/LBF	0	\$26.00	\$35.00	\$0.00	\$0.00	\$0
4LF28/HE/NBF	73	\$26.00	\$35.00	\$1,898.00	\$2,555.00	\$4,453
3LF28/HE/LBF	0	\$24.00	\$35.00	\$0.00	\$0.00	\$0
2LF28/HE/LBF	19	\$22.00	\$35.00	\$418.00	\$665.00	\$1,083
1LF28/HE/LBF	0	\$20.00	\$35.00	\$0.00	\$0.00	\$0
8'-2LF28/HE/LBF	0	\$22.00	\$35.00	\$0.00	\$0.00	\$0
12'-3LF28/HE/LBF	0	\$28.00	\$40.00	\$0.00	\$0.00	\$0
14'-4LF28/HE/LBF	0	\$30.00	\$50.00	\$0.00	\$0.00	\$0
8'-4LF28/HE/LBF	0	\$30.00	\$35.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
1LF17/HE/LBF	0	\$15.00	\$35.00	\$0.00	\$0.00	\$0
2LF17/HE/LBF	2	\$19.00	\$35.00	\$38.00	\$70.00	\$108
1LF25/HE/LBF	0	\$16.00	\$35.00	\$0.00	\$0.00	\$0
2LF25/HE/LBF	0	\$22.00	\$35.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
2LFB30/HE/LBF	0	\$27.00	\$35.00	\$0.00	\$0.00	\$0
4'-1LF28/HE/NBF/WR/N	0	\$50.00	\$75.00	\$0.00	\$0.00	\$0
8'-2LF28/HE/NBF/WR/N	0	\$70.00	\$75.00	\$0.00	\$0.00	\$0
12'-3LF28/HE/NBF/WR/N	0	\$95.00	\$125.00	\$0.00	\$0.00	\$0
16'-4LF28/HE/NBF/WR/N	0	\$125.00	\$175.00	\$0.00	\$0.00	\$0
4'-2LF28/HE/NBF/WR/N	0	\$60.00	\$75.00	\$0.00	\$0.00	\$0
8'-4LF28/HE/LBF/WR/N	0	\$75.00	\$75.00	\$0.00	\$0.00	\$0
4'-1LF28/HE/NBF/IND/N	0	\$50.00	\$75.00	\$0.00	\$0.00	\$0
8'-2LF28/HE/NBF/IND/N	0	\$75.00	\$75.00	\$0.00	\$0.00	\$0
12'-3LF28/HE/NBF/IND/N	0	\$95.00	\$125.00	\$0.00	\$0.00	\$0
16'-4LF28/HE/NBF/IND/N	0	\$125.00	\$175.00	\$0.00	\$0.00	\$0
4'-2LF28/HE/NBF/IND/N	0	\$60.00	\$75.00	\$0.00	\$0.00	\$0
8'-4LF28/HE/LBF/IND/N	0	\$75.00	\$75.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
4'-1LF28/HE/NBF/ST/N	0	\$45.00	\$75.00	\$0.00	\$0.00	\$0
8'-2LF28/HE/NBF/ST/N	0	\$65.00	\$75.00	\$0.00	\$0.00	\$0
12'-3LF28/HE/NBF/ST/N	0	\$90.00	\$125.00	\$0.00	\$0.00	\$0
16'-4LF28/HE/NBF/WST/N	0	\$120.00	\$175.00	\$0.00	\$0.00	\$0
4'-1LF28/HE/NBF/WWR/N	0	\$70.00	\$75.00	\$0.00	\$0.00	\$0
8'-2LF28/HE/NBF/WWR/N	0	\$90.00	\$75.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
14W CF/SI	17	\$9.00	\$10.00	\$153.00	\$170.00	\$323
23W CF/SI	0	\$9.00	\$10.00	\$0.00	\$0.00	\$0
1X4-1LF28/HE/NBF/N	0	\$75.00	\$75.00	\$0.00	\$0.00	\$0
2X4-2LF28/HE/NBF/N	0	\$80.00	\$75.00	\$0.00	\$0.00	\$0
2L-13W CF/HW	0	\$25.00	\$40.00	\$0.00	\$0.00	\$0
1L-13W CF/HW	0	\$22.00	\$40.00	\$0.00	\$0.00	\$0
REMOVE & CAP	0	\$10.00	\$50.00	\$0.00	\$0.00	\$0

MATERIAL & LABOR

**Town of Concord  
Public Safety Complex  
ECM: Lighting Improvements**

**MATERIAL AND LABOR BREAKDOWN**

NEW LED EXIT	0	\$20.00	\$60.00	\$0.00	\$0.00	\$0
1L-13W CF/HW/JAR	0	\$45.00	\$40.00	\$0.00	\$0.00	\$0
175W MH/LB	0	\$175.00	\$200.00	\$0.00	\$0.00	\$0
250W MH/LB	0	\$200.00	\$200.00	\$0.00	\$0.00	\$0
250W MH/HB	0	\$200.00	\$200.00	\$0.00	\$0.00	\$0
400W MH/HB	0	\$275.00	\$200.00	\$0.00	\$0.00	\$0
35W HPS WALL PACK	0	\$95.00	\$125.00	\$0.00	\$0.00	\$0
70W HPS WALL PACK	0	\$95.00	\$125.00	\$0.00	\$0.00	\$0
35W HPS CANOPY	0	\$110.00	\$125.00	\$0.00	\$0.00	\$0
70W HPS CANOPY	0	\$110.00	\$125.00	\$0.00	\$0.00	\$0
35W HPS MINI-FLOOD	0	\$95.00	\$125.00	\$0.00	\$0.00	\$0
70W HPS MINI-FLOOD	2	\$95.00	\$125.00	\$190.00	\$250.00	\$440
150W HPS/FLOOD	0	\$195.00	\$175.00	\$0.00	\$0.00	\$0
250W HPS/FLOOD	0	\$195.00	\$175.00	\$0.00	\$0.00	\$0
400W HPS/FLOOD	0	\$195.00	\$175.00	\$0.00	\$0.00	\$0
100W HPS/LB	0	\$175.00	\$200.00	\$0.00	\$0.00	\$0
150W HPS/LB	0	\$195.00	\$200.00	\$0.00	\$0.00	\$0
4L-T5/HO/N	0	\$200.00	\$250.00	\$0.00	\$0.00	\$0
3L-T5/HO/N	0	\$175.00	\$250.00	\$0.00	\$0.00	\$0
2L-T5/HO/N	0	\$135.00	\$250.00	\$0.00	\$0.00	\$0
4L-T8/HP/N	0	\$130.00	\$150.00	\$0.00	\$0.00	\$0
3L-T8/HP/N	0	\$125.00	\$150.00	\$0.00	\$0.00	\$0
2L-T8/HP/N	0	\$90.00	\$150.00	\$0.00	\$0.00	\$0
1LF59/LBF	0	\$30.00	\$30.00	\$0.00	\$0.00	\$0
2LF59/LBF	0	\$35.00	\$30.00	\$0.00	\$0.00	\$0

**TOTALS :** **393** **\$2,697.00** **\$3,710.00** **\$6,407.00**

<b>HAZARDOUS WASTE</b>	<b>\$385.33</b>
<b>LIGHTING RAW COST</b>	<b>\$6,792.33</b>
<b>TOTAL</b>	<b>\$6,792.33</b>

SIMPLE PAYBACK
5.03

<b>OCCUPANCY SENSORS</b>	<b>QUANTITY</b>	<b>MATERIAL COST</b>	<b>LABOR COST</b>	<b>TOTAL MATERIAL</b>	<b>TOTAL LABOR</b>	<b>TOTAL RAW COST</b>
SWITCH MOUNT	14	\$ 50.00	\$ 35.00	\$700.00	\$490.00	\$1,190.00
CEILING MOUNT	0	\$ 110.00	\$ 150.00	\$0.00	\$0.00	\$0.00

**TOTALS :** **14** **\$700.00** **\$490.00** **\$1,190.00**

C:\Documents and Settings\Owner\Desktop\Concord New\Concord Lighting Revised\[Public Safety lighting 2.xls]EXISTING MAT.

## CODES

EXIST CODE	FIXTURE TYPE	WATTS	# OF LAMPS	# OF BALS.	REPL. CODE	PROPOSED FIXTURE	WATTS	MAT. COST	LABOR COST	# OF BALS.	# OF LAMPS
1	2X4-ACRY-4LF40/EE/EEM	140	4	2	100	NO-RETRO	0	0	0	0	0
2	2X4-ACRY-3LF40/EE/EEM	110	3	2	101						
3	2X4-ACRY-2LF40/EE/EEM	70	2	1	102	4LF28/HE/LBF	82	26	35	1	2
4	2X4-PARA-4LF40/EE/EEM	140	4	2	103	4LF28/HE/NBF	93	26	35	1	4
5	2X4-PARA-3LF40/EE/EEM	110	3	2	104	3LF28/HE/LBF	63	24	35	1	3
6	2X4-PARA-2LF40/EE/EEM	70	2	1	105	2LF28/HE/LBF	42	22	35	1	2
7	1X4-PARA-2LF40/EE/EEM	70	2	1	106	1LF28/HE/LBF	23	20	35	1	1
8	1X4-ACRY-2LF40/EE/EEM	70	2	1	107	8'-2LF28/HE/LBF	42	22	35	1	2
9	2X2-PARA-2LFB40/ES/EEM	70	2	1	108	12'-3LF28/HE/LBF	63	28	40	1	3
10	2X2-ACRY-2LFB40/ES/EEM	70	2	1	109	14'-4LF28/HE/LBF	82	30	50	1	4
11	2X2-ACRY-4LF20/ES/STD	112	4	2	110	8'-4LF28/HE/LBF	82	30	35	1	4
12	4'-WRAP-1LF40/EE/EEM	40	1	1	111						
13	4'-WRAP-2LF40/EE/EEM	70	2	1	112						
14	4'-WRAP-3LF40/EE/EEM	110	3	2	113						
15	4'-WRAP-4LF40/EE/EEM	140	4	2	114						
16	2'-WALL WR-2LF20/EEM/STD	56	2	1	115	1LF17/HE/LBF	15	15	35	1	1
17	4'-WALL WR-1LF40/EE/EEM	40	1	1	116	2LF17/HE/LBF	27	19	35	1	2
18	4'-WALL WR-2LF40/EE/EEM	70	2	1	117	1LF25/HE/LBF	20	16	35	1	1
19	4'-DAMP WR-1LF40/EE/EEM	40	1	1	118	2LF25/HE/LBF	39	22	35	1	2
20	8'-DAMP WR-1LF96/EE/EEM	83	1	1	119						
21	8'-DAMP WR-2LF96/EE/EEM	123	2	1	120						
22	8'-WRAP-4LF40/EE/EEM	140	4	2	121						
23	4'-IND-1LF40/EE/EEM	40	1	1	122	2LFB30/HE/LBF	45	27	35	1	2
24	4'-IND-2LF40/EE/EEM	70	2	1	123	4'-1LF28/HE/NBF/WR/N	25	50	75	1	1
25	4'-IND-3LF40/EE/EEM	110	3	2	124	8'-2LF28/HE/NBF/WR/N	47	70	75	1	2
26	4'-IND-4LF40/EE/EEM	140	4	2	125	12'-3LF28/HE/NBF/WR/N	72	95	125	1	3
27	4'-IND-2LF40/HO/STD	145	2	1	126	16'-4LF28/HE/NBF/WR/N	94	125	175	1	4
28	8'-IND-4LF40/EE/EEM	140	4	2	127	4'-2LF28/HE/NBF/WR/N	47	60	75	1	2
29	8'-IND-2LF96/EE/EEM	123	2	1	128	8'-4LF28/HE/LBF/WR/N	82	75	75	1	4
30	8'-IND-3LF96/EE/EEM	206	3	2	129	4'-1LF28/HE/NBF/IND/N	25	50	75	1	1
31	8'-IND-2LF96/HO/STD	227	2	1	130	8'-2LF28/HE/NBF/IND/N	47	75	75	1	2
32	8'-IND-4LF96/HO/STD	454	4	2	131	12'-3LF28/HE/NBF/IND/N	72	95	125	1	3
33	2'-STR-1LF20/EEM/STD	32	1	1	132	16'-4LF28/HE/NBF/IND/N	94	125	175	1	4
34	3'-STR-1LF30/EEM/STD	46	1	1	133	4'-2LF28/HE/NBF/IND/N	47	60	75	1	2
35	3'-STR-2LF30/EEM/STD	80	2	1	134	8'-4LF28/HE/LBF/IND/N	82	75	75	1	4
36	4'-STR-1LF40/EE/EEM	40	1	1	135						
37	4'-STR-2LF40/EE/EEM	70	2	1	136	4'-1LF28/HE/NBF/ST/N	25	45	75	1	1
38	8'-STR-2LF40/EE/EEM	70	2	1	137	8'-2LF28/HE/NBF/ST/N	47	65	75	1	2
39	8'-STR-1LF96/EE/EEM	83	1	1	138	12'-3LF28/HE/NBF/ST/N	72	90	125	1	3
40	8'-STR-2LF96/EE/EEM	123	2	1	139	16'-4LF28/HE/NBF/WST/N	94	120	175	1	4
41	4'-ICE TRAY-2LF40/EE/EEM	70	2	1	140	4'-1LF28/HE/NBF/WWR/N	25	70	75	1	1
42	8'-ICE TRAY-4LF40/EE/EEM	140	4	2	141	8'-2LF28/HE/NBF/WWR/N	47	90	75	1	2
43	4'-ICE TRAY-4LF40/EE/EEM	140	4	2	142						
44	8'-ICE TRAY-2LF96/EE/EEM	123	2	1	143						
45	8'-ICE TRAY-4LF96/EE/EEM	246	4	2	144	14W CF/SI	14	9	10	0	1
46	4'-BOX-2LF40/EE/EEM	70	2	1	145	23W CF/SI	23	9	10	0	1
47	4'-BOX-3LF40/EE/EEM	110	4	2	146	1X4-1LF28/HE/NBF/N	25	75	75	1	1



## CODES

61	FLUOR EXIT-2L/7W	18	2	0	160	70W HPS CANOPY	90	110	125	1	1
62	FLUOR EXIT-2LF6/T5	20	2	0	161	35W HPS MINI-FLOOD	50	95	125	1	1
63	4'-2LF32/WR	60	2	1	162	70W HPS MINI-FLOOD	90	95	125	1	1
64	FLOODS-1L/150W	150	1	0	163	150W HPS/FLOOD	190	195	175	1	1
65	QUARTZ-IL/300W	300	1	0	164	250W HPS/FLOOD	295	195	175	1	1
66	QUARTZ-IL/500W	500	1	0	165	400W HPS/FLOOD	460	195	175	1	1
67	Metal Halide-1L/150W	190	1	1	166	100W HPS/LB	120	175	200	1	1
68	Metal Halide-1L/250W	290	1	1	167	150W HPS/LB	190	195	200	1	1
69	Metal Halide-1L/400W	455	1	1	168	4L-T5/HO/N	234	200	250	2	4
70	MERCURY VAPOR-1L/1000W	1075	1	1	169	3L-T5/HO/N	177	175	250	2	3
71	MERCURY VAPOR-2L/400W	910	2	2	170	2L-T5/HO/N	117	135	250	1	2
72	2x2-2LFB30/T8	45	2	1	171	4L-T8/HP/N	156	130	150	1	4
73	2X4-4LF32/T8	120	4	1	172	3L-T8/HP/N	112	125	150	1	3
74	2X4-3LF32/T8	88	3	1	173	2L-T8/HP/N	78	90	150	1	2
75	2X4-2LF32/T8	60	2	1	174	1LF59/LBF	57	30	30	1	1
76	70W HPS	90	1	1	175	2LF59/LBF	100	35	30	1	2
77	2LF32/T8	60	2	1							
78	150W HPS	190	1	1							

Town of Concord  
Public Works Department  
ECM: Lighting Improvements

\$/kWh 0.085  
\$/kW -

Location		Existing Conditions						Retrofit Conditions								Sensors		Retrofit Savings		Sensor Savings		Total Savings	
Item #	Room #	Code	# Of Fxts	Existing Fixture	Watts	kW	kWh	Code	# Of Fxts	Replacement Fixture	Watts	kW	kWh	H (h/yr)	FC	Sw Mt.	Ceil Mt.	kW Saved	kWh Saved	kW Saved	kWh Saved	Demand kW Reduction	kWh/year Saved
1	Main Office	72	12	2x2-3LF17/T8	49	0.59	1470	100	12	NO-RETRO	49	0.6	1470	2500		0	0	0.0	0	0.00	0	0.00	0
2	Main Office	74	3	2X4-3LF32/T8	88	0.26	660	100	3	NO-RETRO	88	0.3	660	2500		0	0	0.0	0	0.00	0	0.00	0
3	Vault	13	2	4'-WRAP-2LF40/EE/EEM	70	0.14	70	105	2	2LF28/HE/LBF	42	0.1	42	500		1	0	0.1	28	0.00	11	0.00	39
4	rm 16	74	2	2X4-3LF32/T8	88	0.18	352	100	2	NO-RETRO	88	0.2	352	2000		1	0	0.0	0	0.00	88	0.00	88
5	rm 15	74	2	2X4-3LF32/T8	88	0.18	352	100	2	NO-RETRO	88	0.2	352	2000		1	0	0.0	0	0.00	88	0.00	88
6	rm 14	74	2	2X4-3LF32/T8	88	0.18	352	100	2	NO-RETRO	88	0.2	352	2000		1	0	0.0	0	0.00	88	0.00	88
7	rm 13	74	3	2X4-3LF32/T8	88	0.26	528	100	3	NO-RETRO	88	0.3	528	2000		1	0	0.0	0	0.00	132	0.00	132
8	Vestibule	72	1	2x2-3LF17/T8	49	0.05	123	100	1	NO-RETRO	49	0.0	123	2500		0	0	0.0	0	0.00	0	0.00	0
9	Lunch rm	72	5	2x2-3LF17/T8	49	0.25	123	100	5	NO-RETRO	49	0.2	123	500		1	0	0.0	0	0.00	31	0.00	31
10	Mens rm	74	1	2X4-3LF32/T8	88	0.09	88	100	1	NO-RETRO	88	0.1	88	1000		1	0	0.0	0	0.00	22	0.00	22
11	Womens rm	74	1	2X4-3LF32/T8	88	0.09	88	100	1	NO-RETRO	88	0.1	88	1000		1	0	0.0	0	0.00	22	0.00	22
12	Mech rm	63	4	4'-2LF32/WR	60	0.24	120	100	4	NO-RETRO	60	0.2	120	500		0	0	0.0	0	0.00	0	0.00	0
13	2nd fl main office	74	12	2X4-3LF32/T8	88	1.06	2640	100	12	NO-RETRO	88	1.1	2640	2500		0	0	0.0	0	0.00	0	0.00	0
14	2nd fl rm 108	74	2	2X4-3LF32/T8	88	0.18	352	100	2	NO-RETRO	88	0.2	352	2000		1	0	0.0	0	0.00	88	0.00	88
15	2nd fl rm 107	74	2	2X4-3LF32/T8	88	0.18	352	100	2	NO-RETRO	88	0.2	352	2000		1	0	0.0	0	0.00	88	0.00	88
16	2nd fl rm 106	74	4	2X4-3LF32/T8	88	0.35	704	100	4	NO-RETRO	88	0.4	704	2000		1	0	0.0	0	0.00	176	0.00	176
17	2nd fl rm 105	74	4	2X4-3LF32/T8	88	0.35	704	100	4	NO-RETRO	88	0.4	704	2000		1	0	0.0	0	0.00	176	0.00	176
18	2nd fl rm 104	74	1	2X4-3LF32/T8	88	0.09	176	100	1	NO-RETRO	88	0.1	176	2000		1	0	0.0	0	0.00	44	0.00	44
19	2nd fl rm 104	74	1	2X4-3LF32/T8	88	0.09	176	100	1	NO-RETRO	88	0.1	176	2000		0	0	0.0	0	0.00	0	0.00	0
20	2nd fl rm 103	74	4	2X4-3LF32/T8	88	0.35	704	100	4	NO-RETRO	88	0.4	704	2000		1	0	0.0	0	0.00	176	0.00	176
21	Storage rm 18	29	1	8'-IND-2LF96/EE/EEM	123	0.12	62	175	1	2LF59/LBF	100	0.1	50	500		0	0	0.0	12	0.00	0	0.00	12
22	Garage 19	63	7	4'-2LF32/WR	60	0.42	1050	100	7	NO-RETRO	60	0.4	1050	2500		0	0	0.0	0	0.00	0	0.00	0
23	rm 21	74	3	2X4-3LF32/T8	88	0.26	528	100	3	NO-RETRO	88	0.3	528	2000		1	0	0.0	0	0.00	132	0.00	132
24	rm 20	72	4	2x2-3LF17/T8	49	0.20	392	100	4	NO-RETRO	49	0.2	392	2000		1	0	0.0	0	0.00	98	0.00	98
25	rm 20	74	1	2X4-3LF32/T8	88	0.09	176	100	1	NO-RETRO	88	0.1	176	2000		0	0	0.0	0	0.00	0	0.00	0
26	Garage 22	69	6	Metal Halide-1L/400W	455	2.73	6825	169	6	3L-T5/HO/N	177	1.1	2655	2500		0	0	1.7	4170	0.00	0	0.00	4170
27	Garage 22	29	12	8'-IND-2LF96/EE/EEM	123	1.48	3690	169	4	3L-T5/HO/N	177	0.7	1770	2500		0	0	0.8	1920	0.00	0	0.00	1920
28	Garage 22	39	2	8'-STR-1LF96/EE/EEM	83	0.17	415	174	2	1LF59/LBF	57	0.1	285	2500		0	0	0.1	130	0.00	0	0.00	130
29	Storgae rm 23	63	4	4'-2LF32/WR	60	0.24	600	100	4	NO-RETRO	60	0.2	600	2500		0	0	0.0	0	0.00	0	0.00	0
30	Parts Storage	29	2	8'-IND-2LF96/EE/EEM	123	0.25	615	175	2	2LF59/LBF	100	0.2	500	2500		0	0	0.0	115	0.00	0	0.00	115
31	Lunch rm	74	6	2X4-3LF32/T8	88	0.53	264	100	6	NO-RETRO	88	0.5	264	500		1	0	0.0	0	0.00	66	0.00	66
32	Upper Office	74	2	2X4-3LF32/T8	88	0.18	352	100	2	NO-RETRO	88	0.2	352	2000		1	0	0.0	0	0.00	88	0.00	88
33	Garage 31	29	10	8'-IND-2LF96/EE/EEM	123	1.23	3075	175	10	2LF59/LBF	100	1.0	2500	2500		0	0	0.2	575	0.00	0	0.00	575
34	Garage 36	40	8	8'-STR-2LF96/EE/EEM	123	0.98	2460	175	8	2LF59/LBF	100	0.8	2000	2500		0	0	0.2	460	0.00	0	0.00	460
35	Garage 39	40	11	8'-STR-2LF96/EE/EEM	123	1.35	3383	175	11	2LF59/LBF	100	1.1	2750	2500		0	0	0.3	633	0.00	0	0.00	633

Location		Existing Conditions						Retrofit Conditions								Sensors		Retrofit Savings		Sensor Savings		Total Savings	
Item #	Room #	Code	# Of Fxts	Existing Fixture	Watts	kW	kWh	Code	# Of Fxts	Replacement Fixture	Watts	kW	kWh	H (h/yr)	FC	Sw Mt.	Ceil Mt.	kW Saved	kWh Saved	kW Saved	kWh Saved	Demand kW Reduction	kWh/year Saved
36	Mens rm	5	1	2X4-PARA-3LF40/EE/EEM	110	0.11	110	104	1	3LF28/HE/LBF	63	0.1	63	1000		1	0	0.0	47	0.00	16	0.00	63
37	rm 210	1	1	2X4-ACRY-4LF40/EE/EEM	140	0.14	280	102	1	4LF28/HE/LBF	82	0.1	164	2000		1	0	0.1	116	0.00	41	0.00	157
38	rm 40	1	2	2X4-ACRY-4LF40/EE/EEM	140	0.28	560	102	2	4LF28/HE/LBF	82	0.2	328	2000		1	0	0.1	232	0.00	82	0.00	314
39	exterior	76	22	70W HPS WALL PACK	90	1.98	7920	100	22	NO-RETRO	90	2.0	7920	4000		0	0	0.0	0	0.00	0	0.00	0
TOTALS		173			17.86		42889.00	165			14.36		34452.00			21	0	3.50	8437.00	0.00	1751.88	0.00	10188.88

MATERIAL & LABOR

**Town of Concord**  
**Public Works Department**  
**ECM: Lighting Improvements**  
MATERIAL AND LABOR BREAKDOWN

REPLACEMENT MATERIAL	QUANTITY	MATERIAL COST	LABOR COST	TOTAL MATERIAL	TOTAL LABOR	TOTAL RAW COST
NO-RETRO	115	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
4LF28/HE/LBF	3	\$26.00	\$35.00	\$78.00	\$105.00	\$183
4LF28/HE/NBF	0	\$26.00	\$35.00	\$0.00	\$0.00	\$0
3LF28/HE/LBF	1	\$24.00	\$35.00	\$24.00	\$35.00	\$59
2LF28/HE/LBF	2	\$22.00	\$35.00	\$44.00	\$70.00	\$114
1LF28/HE/LBF	0	\$20.00	\$35.00	\$0.00	\$0.00	\$0
8'-2LF28/HE/LBF	0	\$22.00	\$35.00	\$0.00	\$0.00	\$0
12'-3LF28/HE/LBF	0	\$28.00	\$40.00	\$0.00	\$0.00	\$0
14'-4LF28/HE/LBF	0	\$30.00	\$50.00	\$0.00	\$0.00	\$0
8'-4LF28/HE/LBF	0	\$30.00	\$35.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
1LF17/HE/LBF	0	\$15.00	\$35.00	\$0.00	\$0.00	\$0
2LF17/HE/LBF	0	\$19.00	\$35.00	\$0.00	\$0.00	\$0
1LF25/HE/LBF	0	\$16.00	\$35.00	\$0.00	\$0.00	\$0
2LF25/HE/LBF	0	\$22.00	\$35.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
2LFB30/HE/LBF	0	\$27.00	\$35.00	\$0.00	\$0.00	\$0
4'-1LF28/HE/NBF/WR/N	0	\$50.00	\$75.00	\$0.00	\$0.00	\$0
8'-2LF28/HE/NBF/WR/N	0	\$70.00	\$75.00	\$0.00	\$0.00	\$0
12'-3LF28/HE/NBF/WR/N	0	\$95.00	\$125.00	\$0.00	\$0.00	\$0
16'-4LF28/HE/NBF/WR/N	0	\$125.00	\$175.00	\$0.00	\$0.00	\$0
4'-2LF28/HE/NBF/WR/N	0	\$60.00	\$75.00	\$0.00	\$0.00	\$0
8'-4LF28/HE/LBF/WR/N	0	\$75.00	\$75.00	\$0.00	\$0.00	\$0
4'-1LF28/HE/NBF/IND/N	0	\$50.00	\$75.00	\$0.00	\$0.00	\$0
8'-2LF28/HE/NBF/IND/N	0	\$75.00	\$75.00	\$0.00	\$0.00	\$0
12'-3LF28/HE/NBF/IND/N	0	\$95.00	\$125.00	\$0.00	\$0.00	\$0
16'-4LF28/HE/NBF/IND/N	0	\$125.00	\$175.00	\$0.00	\$0.00	\$0
4'-2LF28/HE/NBF/IND/N	0	\$60.00	\$75.00	\$0.00	\$0.00	\$0
8'-4LF28/HE/LBF/IND/N	0	\$75.00	\$75.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
4'-1LF28/HE/NBF/ST/N	0	\$45.00	\$75.00	\$0.00	\$0.00	\$0
8'-2LF28/HE/NBF/ST/N	0	\$65.00	\$75.00	\$0.00	\$0.00	\$0
12'-3LF28/HE/NBF/ST/N	0	\$90.00	\$125.00	\$0.00	\$0.00	\$0
16'-4LF28/HE/NBF/WST/N	0	\$120.00	\$175.00	\$0.00	\$0.00	\$0
4'-1LF28/HE/NBF/WWR/N	0	\$70.00	\$75.00	\$0.00	\$0.00	\$0
8'-2LF28/HE/NBF/WWR/N	0	\$90.00	\$75.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
15W CF/SI	0	\$9.00	\$10.00	\$0.00	\$0.00	\$0
23W CF/SI	0	\$9.00	\$10.00	\$0.00	\$0.00	\$0
1X4-1LF28/HE/NBF/N	0	\$75.00	\$75.00	\$0.00	\$0.00	\$0
2X4-2LF28/HE/NBF/N	0	\$80.00	\$75.00	\$0.00	\$0.00	\$0
2L-13W CF/HW	0	\$25.00	\$40.00	\$0.00	\$0.00	\$0
1L-13W CF/HW	0	\$22.00	\$40.00	\$0.00	\$0.00	\$0
REMOVE & CAP	0	\$10.00	\$50.00	\$0.00	\$0.00	\$0

MATERIAL & LABOR

**Town of Concord  
Public Works Department  
ECM: Lighting Improvements**

**MATERIAL AND LABOR BREAKDOWN**

NEW LED EXIT	0	\$20.00	\$60.00	\$0.00	\$0.00	\$0
1L-13W CF/HW/JAR	0	\$45.00	\$40.00	\$0.00	\$0.00	\$0
175W MH/LB	0	\$175.00	\$200.00	\$0.00	\$0.00	\$0
250W MH/LB	0	\$200.00	\$200.00	\$0.00	\$0.00	\$0
250W MH/HB	0	\$200.00	\$200.00	\$0.00	\$0.00	\$0
400W MH/HB	0	\$275.00	\$200.00	\$0.00	\$0.00	\$0
35W HPS WALL PACK	0	\$95.00	\$125.00	\$0.00	\$0.00	\$0
70W HPS WALL PACK	0	\$95.00	\$125.00	\$0.00	\$0.00	\$0
35W HPS CANOPY	0	\$110.00	\$125.00	\$0.00	\$0.00	\$0
70W HPS CANOPY	0	\$110.00	\$125.00	\$0.00	\$0.00	\$0
35W HPS MINI-FLOOD	0	\$95.00	\$125.00	\$0.00	\$0.00	\$0
70W HPS MINI-FLOOD	0	\$95.00	\$125.00	\$0.00	\$0.00	\$0
150W HPS/FLOOD	0	\$195.00	\$175.00	\$0.00	\$0.00	\$0
250W HPS/FLOOD	0	\$195.00	\$175.00	\$0.00	\$0.00	\$0
400W HPS/FLOOD	0	\$195.00	\$175.00	\$0.00	\$0.00	\$0
100W HPS/LB	0	\$175.00	\$200.00	\$0.00	\$0.00	\$0
150W HPS/LB	0	\$195.00	\$200.00	\$0.00	\$0.00	\$0
4L-T5/HO/N	0	\$200.00	\$250.00	\$0.00	\$0.00	\$0
3L-T5/HO/N	10	\$175.00	\$250.00	\$1,750.00	\$2,500.00	\$4,250
2L-T5/HO/N	0	\$135.00	\$250.00	\$0.00	\$0.00	\$0
4L-T8/HP/N	0	\$130.00	\$150.00	\$0.00	\$0.00	\$0
3L-T8/HP/N	0	\$125.00	\$150.00	\$0.00	\$0.00	\$0
2L-T8/HP/N	0	\$90.00	\$150.00	\$0.00	\$0.00	\$0
1LF59/LBF	2	\$30.00	\$30.00	\$60.00	\$60.00	\$120
2LF59/LBF	32	\$35.00	\$30.00	\$1,120.00	\$960.00	\$2,080

**TOTALS :** **165** **\$3,076.00** **\$3,730.00** **\$6,806.00**

<b>HAZARDOUS WASTE</b>	<b>\$215.84</b>
<b>LIGHTING RAW COST</b>	<b>\$7,021.84</b>
<b>TOTAL</b>	<b>\$7,021.84</b>

SIMPLE PAYBACK
10.17

<b>OCCUPANCY SENSORS</b>	<b>QUANTITY</b>	<b>MATERIAL COST</b>	<b>LABOR COST</b>	<b>TOTAL MATERIAL</b>	<b>TOTAL LABOR</b>	<b>TOTAL RAW COST</b>
SWITCH MOUNT	21	\$ 50.00	\$ 35.00	\$1,050.00	\$735.00	\$1,785.00
CEILING MOUNT	0	\$ 110.00	\$ 150.00	\$0.00	\$0.00	\$0.00

**TOTALS :** **21** **\$1,050.00** **\$735.00** **\$1,785.00**

C:\Documents and Settings\Owner\Desktop\Concord New\Concord Lighting Revised\CPW lighting 2.xls]EXISTING MAT.



## CODES

EXIST CODE	FIXTURE TYPE	WATTS	# OF LAMPS	# OF BALS.	REPL. CODE	PROPOSED FIXTURE	WATTS	MAT. COST	LABOR COST	# OF BALS.	# OF LAMPS
1	2X4-ACRY-4LF40/EE/EEM	140	4	2	100	NO-RETRO	0	0	0	0	0
2	2X4-ACRY-3LF40/EE/EEM	110	3	2	101						
3	2X4-ACRY-2LF40/EE/EEM	70	2	1	102	4LF28/HE/LBF	82	26	35	1	2
4	2X4-PARA-4LF40/EE/EEM	140	4	2	103	4LF28/HE/NBF	93	26	35	1	4
5	2X4-PARA-3LF40/EE/EEM	110	3	2	104	3LF28/HE/LBF	63	24	35	1	3
6	2X4-PARA-2LF40/EE/EEM	70	2	1	105	2LF28/HE/LBF	42	22	35	1	2
7	1X4-PARA-2LF40/EE/EEM	70	2	1	106	1LF28/HE/LBF	23	20	35	1	1
8	1X4-ACRY-2LF40/EE/EEM	70	2	1	107	8'-2LF28/HE/LBF	42	22	35	1	2
9	2X2-PARA-2LFB40/ES/EEM	70	2	1	108	12'-3LF28/HE/LBF	63	28	40	1	3
10	2X2-ACRY-2LFB40/ES/EEM	70	2	1	109	14'-4LF28/HE/LBF	82	30	50	1	4
11	2X2-ACRY-4LF20/ES/STD	112	4	2	110	8'-4LF28/HE/LBF	82	30	35	1	4
12	4'-WRAP-1LF40/EE/EEM	40	1	1	111						
13	4'-WRAP-2LF40/EE/EEM	70	2	1	112						
14	4'-WRAP-3LF40/EE/EEM	110	3	2	113						
15	4'-WRAP-4LF40/EE/EEM	140	4	2	114						
16	2'-WALL WR-2LF20/EEM/STD	56	2	1	115	1LF17/HE/LBF	15	15	35	1	1
17	4'-WALL WR-1LF40/EE/EEM	40	1	1	116	2LF17/HE/LBF	27	19	35	1	2
18	4'-WALL WR-2LF40/EE/EEM	70	2	1	117	1LF25/HE/LBF	20	16	35	1	1
19	4'-DAMP WR-1LF40/EE/EEM	40	1	1	118	2LF25/HE/LBF	39	22	35	1	2
20	8'-DAMP WR-1LF96/EE/EEM	83	1	1	119						
21	8'-DAMP WR-2LF96/EE/EEM	123	2	1	120						
22	8'-WRAP-4LF40/EE/EEM	140	4	2	121						
23	4'-IND-1LF40/EE/EEM	40	1	1	122	2LFB30/HE/LBF	45	27	35	1	2
24	4'-IND-2LF40/EE/EEM	70	2	1	123	4'-1LF28/HE/NBF/WR/N	25	50	75	1	1
25	4'-IND-3LF40/EE/EEM	110	3	2	124	8'-2LF28/HE/NBF/WR/N	47	70	75	1	2
26	4'-IND-4LF40/EE/EEM	140	4	2	125	12'-3LF28/HE/NBF/WR/N	72	95	125	1	3
27	4'-IND-2LF40/HO/STD	145	2	1	126	16'-4LF28/HE/NBF/WR/N	94	125	175	1	4
28	8'-IND-4LF40/EE/EEM	140	4	2	127	4'-2LF28/HE/NBF/WR/N	47	60	75	1	2
29	8'-IND-2LF96/EE/EEM	123	2	1	128	8'-4LF28/HE/LBF/WR/N	82	75	75	1	4
30	8'-IND-3LF96/EE/EEM	206	3	2	129	4'-1LF28/HE/NBF/IND/N	25	50	75	1	1
31	8'-IND-2LF96/HO/STD	227	2	1	130	8'-2LF28/HE/NBF/IND/N	47	75	75	1	2
32	8'-IND-4LF96/HO/STD	454	4	2	131	12'-3LF28/HE/NBF/IND/N	72	95	125	1	3
33	2'-STR-1LF20/EEM/STD	32	1	1	132	16'-4LF28/HE/NBF/IND/N	94	125	175	1	4
34	3'-STR-1LF30/EEM/STD	46	1	1	133	4'-2LF28/HE/NBF/IND/N	47	60	75	1	2
35	3'-STR-2LF30/EEM/STD	80	2	1	134	8'-4LF28/HE/LBF/IND/N	82	75	75	1	4
36	4'-STR-1LF40/EE/EEM	40	1	1	135						
37	4'-STR-2LF40/EE/EEM	70	2	1	136	4'-1LF28/HE/NBF/ST/N	25	45	75	1	1
38	8'-STR-2LF40/EE/EEM	70	2	1	137	8'-2LF28/HE/NBF/ST/N	47	65	75	1	2
39	8'-STR-1LF96/EE/EEM	83	1	1	138	12'-3LF28/HE/NBF/ST/N	72	90	125	1	3
40	8'-STR-2LF96/EE/EEM	123	2	1	139	16'-4LF28/HE/NBF/WST/N	94	120	175	1	4
41	4'-ICE TRAY-2LF40/EE/EEM	70	2	1	140	4'-1LF28/HE/NBF/WWR/N	25	70	75	1	1
42	8'-ICE TRAY-4LF40/EE/EEM	140	4	2	141	8'-2LF28/HE/NBF/WWR/N	47	90	75	1	2
43	4'-ICE TRAY-4LF40/EE/EEM	140	4	2	142						
44	8'-ICE TRAY-2LF96/EE/EEM	123	2	1	143						
45	8'-ICE TRAY-4LF96/EE/EEM	246	4	2	144	15W CF/SI	15	9	10	0	1
46	4'-BOX-2LF40/EE/EEM	70	2	1	145	23W CF/SI	23	9	10	0	1
47	4'-BOX-3LF40/EE/EEM	110	4	2	146	1X4-1LF28/HE/NBF/N	25	75	75	1	1

## CODES

[illegible]

Town of Concord  
West Fire Station  
ECM: Lighting Improvements

\$/kWh 0.085  
\$/kW -

Location		Existing Conditions						Retrofit Conditions								Sensors		Retrofit Savings		Sensor Savings		Total Savings							
Item #	Room #	Code	# Of Fxts	Existing Fixture	Watts	kW	kWh	Code	# Of Fxts	Replacement Fixture	Watts	kW	kWh	H (h/yr)	FC	Sw Mt.	Ceil Mt.	kW Saved	kWh Saved	kW Saved	kWh Saved	Demand kW Reduction	kWh/year Saved						
1	boiler rm	48	5	INCAND-1L/90W	90	0.45	225	144	5	14W CF/SI	14	0.1	35	500		0	0	1.0	190	0.00	0	0.00	190						
2	coat rm	73	2	2LF32/T8	60	0.12	240	100	2	NO-RETRO	60	0.1	240	2000		0	0	0.0	0	0.00	0	0.00	0						
3	mens rm	73	2	2LF32/T8	60	0.12	120	100	2	NO-RETRO	60	0.1	120	1000		0	0	0.0	0	0.00	0	0.00	0						
4	truck bay	73	30	2LF32/T8	60	1.80	4500	100	30	NO-RETRO	60	1.8	4500	2500		0	0	0.0	0	0.00	0	0.00	0						
5	office	73	2	2LF32/T8	60	0.12	300	100	2	NO-RETRO	60	0.1	300	2500		1	0	0.0	0	0.00	75	0.00	75						
6	hose hanging rm	48	3	INCAND-1L/90W	90	0.27	135	144	3	14W CF/SI	14	0.0	21	500		0	0	0.2	114	0.00	0	0.00	114						
7	2nd fl hall	10	3	4'-WRAP-2LF40/EE/EEM	70	0.21	525	105	3	2LF28/HE/LBF	42	0.1	315	2500		0	0	0.1	210	0.00	0	0.00	210						
8	kitchen	10	5	4'-WRAP-2LF40/EE/EEM	70	0.35	350	105	5	2LF28/HE/LBF	42	0.2	210	1000		0	0	0.1	140	0.00	0	0.00	140						
9	office	10	1	4'-WRAP-2LF40/EE/EEM	70	0.07	175	105	1	2LF28/HE/LBF	42	0.0	105	2500		1	0	0.0	70	0.00	26	0.00	96						
10	laundry	10	1	4'-WRAP-2LF40/EE/EEM	70	0.07	70	105	1	2LF28/HE/LBF	42	0.0	42	1000		0	0	0.0	28	0.00	0	0.00	28						
11	bed room	47	1	INCAND-1L/60W	60	0.06	60	144	1	14W CF/SI	14	0.0	14	1000		0	0	0.0	46	0.00	0	0.00	46						
12	rec room	10	3	4'-WRAP-2LF40/EE/EEM	70	0.21	210	105	3	2LF28/HE/LBF	42	0.1	126	1000		0	0	0.1	84	0.00	0	0.00	84						
13	bed room	47	1	INCAND-1L/60W	60	0.06	60	144	1	14W CF/SI	14	0.0	14	1000		0	0	0.0	46	0.00	0	0.00	46						
14	bed room	47	1	INCAND-1L/60W	60	0.06	60	144	1	14W CF/SI	14	0.0	14	1000		0	0	0.0	46	0.00	0	0.00	46						
15	exterior	48	2	INCAND-1L/90W	90	0.18	720	162	1	70W HPS MINI-FLOOD	90	0.1	360	4000		0	0	0.1	360	0.00	0	0.00	360						
16	exterior	58	1	QUARTZ-IL/300W	300	0.30	1200	162	1	70W HPS MINI-FLOOD	90	0.1	360	4000		0	0	0.2	840	0.00	0	0.00	840						
TOTALS		63		4.45		8950.00		62		3.04		6776.00		2		0		2.03		2174.00		0.00		101.25		0.00		2275.25	

MATERIAL & LABOR

**Town of Concord**  
**West Fire Station**  
**ECM: Lighting Improvements**  
MATERIAL AND LABOR BREAKDOWN

REPLACEMENT MATERIAL	QUANTITY	MATERIAL COST	LABOR COST	TOTAL MATERIAL	TOTAL LABOR	TOTAL RAW COST
NO-RETRO	36	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
4LF28/HE/LBF	0	\$26.00	\$35.00	\$0.00	\$0.00	\$0
4LF28/HE/NBF	0	\$26.00	\$35.00	\$0.00	\$0.00	\$0
3LF28/HE/LBF	0	\$24.00	\$35.00	\$0.00	\$0.00	\$0
2LF28/HE/LBF	13	\$22.00	\$35.00	\$286.00	\$455.00	\$741
1LF28/HE/LBF	0	\$20.00	\$35.00	\$0.00	\$0.00	\$0
8'-2LF28/HE/LBF	0	\$22.00	\$35.00	\$0.00	\$0.00	\$0
12'-3LF28/HE/LBF	0	\$28.00	\$40.00	\$0.00	\$0.00	\$0
14'-4LF28/HE/LBF	0	\$30.00	\$50.00	\$0.00	\$0.00	\$0
8'-4LF28/HE/LBF	0	\$30.00	\$35.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
1LF17/HE/LBF	0	\$15.00	\$35.00	\$0.00	\$0.00	\$0
2LF17/HE/LBF	0	\$19.00	\$35.00	\$0.00	\$0.00	\$0
1LF25/HE/LBF	0	\$16.00	\$35.00	\$0.00	\$0.00	\$0
2LF25/HE/LBF	0	\$22.00	\$35.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
2LFB30/HE/LBF	0	\$27.00	\$35.00	\$0.00	\$0.00	\$0
4'-1LF28/HE/NBF/WR/N	0	\$50.00	\$75.00	\$0.00	\$0.00	\$0
8'-2LF28/HE/NBF/WR/N	0	\$70.00	\$75.00	\$0.00	\$0.00	\$0
12'-3LF28/HE/NBF/WR/N	0	\$95.00	\$125.00	\$0.00	\$0.00	\$0
16'-4LF28/HE/NBF/WR/N	0	\$125.00	\$175.00	\$0.00	\$0.00	\$0
4'-2LF28/HE/NBF/WR/N	0	\$60.00	\$75.00	\$0.00	\$0.00	\$0
8'-4LF28/HE/LBF/WR/N	0	\$75.00	\$75.00	\$0.00	\$0.00	\$0
4'-1LF28/HE/NBF/IND/N	0	\$50.00	\$75.00	\$0.00	\$0.00	\$0
8'-2LF28/HE/NBF/IND/N	0	\$75.00	\$75.00	\$0.00	\$0.00	\$0
12'-3LF28/HE/NBF/IND/N	0	\$95.00	\$125.00	\$0.00	\$0.00	\$0
16'-4LF28/HE/NBF/IND/N	0	\$125.00	\$175.00	\$0.00	\$0.00	\$0
4'-2LF28/HE/NBF/IND/N	0	\$60.00	\$75.00	\$0.00	\$0.00	\$0
8'-4LF28/HE/LBF/IND/N	0	\$75.00	\$75.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
4'-1LF28/HE/NBF/ST/N	0	\$45.00	\$75.00	\$0.00	\$0.00	\$0
8'-2LF28/HE/NBF/ST/N	0	\$65.00	\$75.00	\$0.00	\$0.00	\$0
12'-3LF28/HE/NBF/ST/N	0	\$90.00	\$125.00	\$0.00	\$0.00	\$0
16'-4LF28/HE/NBF/WST/N	0	\$120.00	\$175.00	\$0.00	\$0.00	\$0
4'-1LF28/HE/NBF/WWR/N	0	\$70.00	\$75.00	\$0.00	\$0.00	\$0
8'-2LF28/HE/NBF/WWR/N	0	\$90.00	\$75.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
30W CF/SI	0	\$9.00	\$0.00	\$0.00	\$0.00	\$0
14W CF/SI	11	\$9.00	\$10.00	\$99.00	\$110.00	\$209
23W CF/SI	0	\$9.00	\$10.00	\$0.00	\$0.00	\$0
1X4-1LF28/HE/NBF/N	0	\$75.00	\$75.00	\$0.00	\$0.00	\$0
2X4-2LF28/HE/NBF/N	0	\$80.00	\$75.00	\$0.00	\$0.00	\$0
2L-13W CF/HW	0	\$25.00	\$40.00	\$0.00	\$0.00	\$0
1L-13W CF/HW	0	\$22.00	\$40.00	\$0.00	\$0.00	\$0
REMOVE & CAP	0	\$10.00	\$50.00	\$0.00	\$0.00	\$0

MATERIAL & LABOR

**Town of Concord  
West Fire Station  
ECM: Lighting Improvements**

**MATERIAL AND LABOR BREAKDOWN**

NEW LED EXIT	0	\$20.00	\$60.00	\$0.00	\$0.00	\$0
1L-13W CF/HW/JAR	0	\$45.00	\$40.00	\$0.00	\$0.00	\$0
175W MH/LB	0	\$175.00	\$200.00	\$0.00	\$0.00	\$0
250W MH/LB	0	\$200.00	\$200.00	\$0.00	\$0.00	\$0
250W MH/HB	0	\$200.00	\$200.00	\$0.00	\$0.00	\$0
400W MH/HB	0	\$275.00	\$200.00	\$0.00	\$0.00	\$0
35W HPS WALL PACK	0	\$95.00	\$125.00	\$0.00	\$0.00	\$0
70W HPS WALL PACK	0	\$95.00	\$125.00	\$0.00	\$0.00	\$0
35W HPS CANOPY	0	\$110.00	\$125.00	\$0.00	\$0.00	\$0
70W HPS CANOPY	0	\$110.00	\$125.00	\$0.00	\$0.00	\$0
35W HPS MINI-FLOOD	0	\$95.00	\$125.00	\$0.00	\$0.00	\$0
70W HPS MINI-FLOOD	2	\$95.00	\$125.00	\$190.00	\$250.00	\$440
150W HPS/FLOOD	0	\$195.00	\$175.00	\$0.00	\$0.00	\$0
250W HPS/FLOOD	0	\$195.00	\$175.00	\$0.00	\$0.00	\$0
400W HPS/FLOOD	0	\$195.00	\$175.00	\$0.00	\$0.00	\$0
100W HPS/LB	0	\$175.00	\$200.00	\$0.00	\$0.00	\$0
150W HPS/LB	0	\$195.00	\$200.00	\$0.00	\$0.00	\$0
4L-T5/HO/N	0	\$200.00	\$250.00	\$0.00	\$0.00	\$0
3L-T5/HO/N	0	\$175.00	\$250.00	\$0.00	\$0.00	\$0
2L-T5/HO/N	0	\$135.00	\$250.00	\$0.00	\$0.00	\$0
4L-T8/HP/N	0	\$130.00	\$150.00	\$0.00	\$0.00	\$0
3L-T8/HP/N	0	\$125.00	\$150.00	\$0.00	\$0.00	\$0
2L-T8/HP/N	0	\$90.00	\$150.00	\$0.00	\$0.00	\$0
1LF59/LBF	0	\$30.00	\$30.00	\$0.00	\$0.00	\$0
2LF59/LBF	0	\$35.00	\$30.00	\$0.00	\$0.00	\$0
2L-T8/HP/N	0	\$90.00	\$150.00	\$0.00	\$0.00	\$0
1LF59/LBF	0	\$30.00	\$30.00	\$0.00	\$0.00	\$0
2LF59/LBF	0	\$35.00	\$30.00	\$0.00	\$0.00	\$0

**TOTALS :** **62** **\$575.00** **\$815.00** **\$1,390.00**

<b>HAZARDOUS WASTE</b>	<b>\$47.29</b>
<b>LIGHTING RAW COST</b>	<b>\$1,437.29</b>
<b>TOTAL</b>	<b>\$1,437.29</b>

SIMPLE PAYBACK
8.31

<b>OCCUPANCY SENSORS</b>	<b>QUANTITY</b>	<b>MATERIAL COST</b>	<b>LABOR COST</b>	<b>TOTAL MATERIAL</b>	<b>TOTAL LABOR</b>	<b>TOTAL RAW COST</b>
SWITCH MOUNT	2	\$ 50.00	\$ 35.00	\$100.00	\$70.00	\$170.00
CEILING MOUNT	0	\$ 110.00	\$ 150.00	\$0.00	\$0.00	\$0.00

**TOTALS :** **2** **\$100.00** **\$70.00** **\$170.00**

C:\Documents and Settings\Owner\Desktop\Concord New\Concord Lighting Revised\[W Fire lighting 2.xls]EXISTING MAT.



## CODES

EXIST CODE	FIXTURE TYPE	WATTS	# OF LAMPS	# OF BALS.	REPL. CODE	PROPOSED FIXTURE	WATTS	MAT. COST	LABOR COST	# OF BALS.	# OF LAMPS
1	2X4-4LF40/EE/EEM	140	4	2	100	NO-RETRO	0	0	0	0	0
2	2X4-3LF40/EE/EEM	110	3	2	101						
3	2X4-2LF40/EE/EEM	70	2	1	102	4LF28/HE/LBF	82	26	35	1	2
4	1X4-2LF40/EE/EEM	70	2	1	103	4LF28/HE/NBF	93	26	35	1	4
5					104	3LF28/HE/LBF	63	24	35	1	3
6	2X2-2LFB40/ES/EEM	70	2	1	105	2LF28/HE/LBF	42	22	35	1	2
7	2X2-4LF20/ES/STD	112	4	2	106	1LF28/HE/LBF	23	20	35	1	1
8					107	8'-2LF28/HE/LBF	42	22	35	1	2
9	4'-WRAP-1LF40/EE/EEM	40	1	1	108	12'-3LF28/HE/LBF	63	28	40	1	3
10	4'-WRAP-2LF40/EE/EEM	70	2	1	109	14'-4LF28/HE/LBF	82	30	50	1	4
11	4'-WRAP-3LF40/EE/EEM	110	3	2	110	8'-4LF28/HE/LBF	82	30	35	1	4
12	4'-WRAP-4LF40/EE/EEM	140	4	2	111						
13	2'-WALL WR-2LF20/EEM/STD	56	2	1	112						
14	4'-WALL WR-1LF40/EE/EEM	40	1	1	113						
15	4'-WALL WR-2LF40/EE/EEM	70	2	1	114						
16	4'-DAMP WR-1LF40/EE/EEM	40	1	1	115	1LF17/HE/LBF	15	15	35	1	1
17	8'-DAMP WR-1LF96/EE/EEM	83	1	1	116	2LF17/HE/LBF	27	19	35	1	2
18	8'-DAMP WR-2LF96/EE/EEM	123	2	1	117	1LF25/HE/LBF	20	16	35	1	1
19	8'-WRAP-4LF40/EE/EEM	140	4	2	118	2LF25/HE/LBF	39	22	35	1	2
20	4'-IND-1LF40/EE/EEM	40	1	1	119						
21	4'-IND-2LF40/EE/EEM	70	2	1	120						
22	4'-IND-3LF40/EE/EEM	110	3	2	121						
23	4'-IND-4LF40/EE/EEM	140	4	2	122	2LFB30/HE/LBF	45	27	35	1	2
24	4'-IND-2LF40/HO/STD	145	2	1	123	4'-1LF28/HE/NBF/WR/N	25	50	75	1	1
25	8'-IND-4LF40/EE/EEM	140	4	2	124	8'-2LF28/HE/NBF/WR/N	47	70	75	1	2
26	8'-IND-2LF96/EE/EEM	123	2	1	125	12'-3LF28/HE/NBF/WR/N	72	95	125	1	3
27	8'-IND-3LF96/EE/EEM	206	3	2	126	16'-4LF28/HE/NBF/WR/N	94	125	175	1	4
28	8'-IND-2LF96/HO/STD	227	2	1	127	4'-2LF28/HE/NBF/WR/N	47	60	75	1	2
29	8'-IND-4LF96/HO/STD	454	4	2	128	8'-4LF28/HE/LBF/WR/N	82	75	75	1	4
30	2'-STR-1LF20/EEM/STD	32	1	1	129	4'-1LF28/HE/NBF/IND/N	25	50	75	1	1
31	3'-STR-1LF30/EEM/STD	46	1	1	130	8'-2LF28/HE/NBF/IND/N	47	75	75	1	2
32	3'-STR-2LF30/EEM/STD	80	2	1	131	12'-3LF28/HE/NBF/IND/N	72	95	125	1	3
33	4'-STR-1LF40/EE/EEM	40	1	1	132	16'-4LF28/HE/NBF/IND/N	94	125	175	1	4
34	4'-STR-2LF40/EE/EEM	70	2	1	133	4'-2LF28/HE/NBF/IND/N	47	60	75	1	2
35	8'-STR-2LF40/EE/EEM	70	2	1	134	8'-4LF28/HE/LBF/IND/N	82	75	75	1	4
36	8'-STR-1LF96/EE/EEM	83	1	1	135						
37	8'-STR-2LF96/EE/EEM	123	2	1	136	4'-1LF28/HE/NBF/ST/N	25	45	75	1	1
38	4'-ICE TRAY-2LF40/EE/EEM	70	2	1	137	8'-2LF28/HE/NBF/ST/N	47	65	75	1	2
39	8'-ICE TRAY-4LF40/EE/EEM	140	4	2	138	12'-3LF28/HE/NBF/ST/N	72	90	125	1	3
40	4'-ICE TRAY-1LF40/EE/EEM	40	1	1	139	16'-4LF28/HE/NBF/WST/N	94	120	175	1	4
41	8'-ICE TRAY-2LF96/EE/EEM	123	2	1	140	4'-1LF28/HE/NBF/WWR/N	25	70	75	1	1
42	8'-ICE TRAY-4LF96/EE/EEM	246	4	2	141	8'-2LF28/HE/NBF/WWR/N	47	90	75	1	2
43	4'-BOX-2LF40/EE/EEM	70	2	1	142						
44	4'-BOX-3LF40/EE/EEM	110	4	2	143	30W CF/SI	30	9		0	1
45					144	14W CF/SI	14	9	10	0	1
46					145	23W CF/SI	23	9	10	0	1
47	INCAND-1L/60W	60	1	0	146	1X4-1LF28/HE/NBF/N	25	75	75	1	1

## CODES

61	150W Metal Halide	190	1	1	160	70W HPS CANOPY	90	110	125	1	1
62	250W Metal Halide	290	1	1	161	35W HPS MINI-FLOOD	50	95	125	1	1
63	400W Metal Halide	455	1	1	162	70W HPS MINI-FLOOD	90	95	125	1	1
64	70W HPS	90	1	1	163	150W HPS/FLOOD	190	195	175	1	1
65	150W HPS	190	1	1	164	250W HPS/FLOOD	295	195	175	1	1
66	250W HPS	290	1	1	165	400W HPS/FLOOD	460	195	175	1	1
67	400W HPS	455	1	1	166	100W HPS/LB	120	175	200	1	1
68					167	150W HPS/LB	190	195	200	1	1
69	2X4-4LF32/T8	120	4	1	168	4L-T5/HO/N	234	200	250	2	4
70	2X4-3LF32/T8	88	3	1	169	3L-T5/HO/N	177	175	250	2	3
71	2X4-2LF32/T8	60	2	1	170	2L-T5/HO/N	117	135	250	1	2
72	2x2-2LFB30/T8	45	2	1	171	4L-T8/HP/N	156	130	150	1	4
73	2LF32/T8	60	2	1	172	3L-T8/HP/N	112	125	150	1	3
74					173	2L-T8/HP/N	78	90	150	1	2
75					174	1LF59/LBF	57	30	30	1	1
76					175	2LF59/LBF	100	35	30	1	2
77					176						
78					177						

Town of Concord  
Water & Sewer Division  
ECM: Lighting Improvements

\$/kWh 0.085  
\$/kW -

Location		Existing Conditions						Retrofit Conditions								Sensors		Retrofit Savings		Sensor Savings		Total Savings	
Item #	Room #	Code	# Of Fxts	Existing Fixture	Watts	kW	kWh	Code	# Of Fxts	Replacement Fixture	Watts	kW	kWh	H (h/yr)	FC	Sw Mt.	Ceil Mt.	kW Saved	kWh Saved	kW Saved	kWh Saved	Demand kW Reduction	kWh/year Saved
1	Conference rm	74	4	2X4-3LF32/T8	88	0.35	176	100	4	NO-RETRO	88	0.4	176	500		1	0	0.0	0	0.00	44	0.00	44
2	Main Office	74	16	2X4-3LF32/T8	88	1.41	3520	100	16	NO-RETRO	88	1.4	3520	2500		0	0	0.0	0	0.00	0	0.00	0
3	Rm 210	74	2	2X4-3LF32/T8	88	0.18	352	100	2	NO-RETRO	88	0.2	352	2000		1	0	0.0	0	0.00	88	0.00	88
4	Rm 212	74	2	2X4-3LF32/T8	88	0.18	352	100	2	NO-RETRO	88	0.2	352	2000		1	0	0.0	0	0.00	88	0.00	88
5	Rm 214	74	2	2X4-3LF32/T8	88	0.18	352	100	2	NO-RETRO	88	0.2	352	2000		1	0	0.0	0	0.00	88	0.00	88
6	Rm 216a	5	2	2X4-PARA-3LF40/EE/EEM	110	0.22	440	104	2	3LF28/HE/LBF	63	0.1	252	2000		1	0	0.1	188	0.00	63	0.00	251
7	Rm 216b	5	2	2X4-PARA-3LF40/EE/EEM	110	0.22	440	104	2	3LF28/HE/LBF	63	0.1	252	2000		1	0	0.1	188	0.00	63	0.00	251
8	Hall	4	5	2X4-PARA-4LF40/EE/EEM	140	0.70	1750	102	5	4LF28/HE/LBF	82	0.4	1025	2500		0	0	0.3	725	0.00	0	0.00	725
9	Storage 202	13	1	4'-WRAP-2LF40/EE/EEM	70	0.07	35	105	1	2LF28/HE/LBF	42	0.0	21	500		1	0	0.0	14	0.00	5	0.00	19
10	Womens rm	72	3	2x2-3LF17/T8	49	0.15	147	100	3	NO-RETRO	49	0.1	147	1000		0	0	0.0	0	0.00	0	0.00	0
11	Mens rm	72	10	2x2-3LF17/T8	49	0.49	490	100	10	NO-RETRO	49	0.5	490	1000		0	0	0.0	0	0.00	0	0.00	0
12	Lab 213	74	1	2X4-3LF32/T8	88	0.09	176	100	1	NO-RETRO	88	0.1	176	2000		1	0	0.0	0	0.00	44	0.00	44
13	Rm 215	74	2	2X4-3LF32/T8	88	0.18	352	100	2	NO-RETRO	88	0.2	352	2000		1	0	0.0	0	0.00	88	0.00	88
14	Rm 218	1	2	2X4-ACRY-4LF40/EE/EEM	140	0.28	560	102	2	4LF28/HE/LBF	82	0.2	328	2000		1	0	0.1	232	0.00	82	0.00	314
15	Lunch rm	13	9	4'-WRAP-2LF40/EE/EEM	70	0.63	315	105	9	2LF28/HE/LBF	42	0.4	189	500		0	1	0.3	126	0.00	47	0.00	173
16	Computer rm	13	5	4'-WRAP-2LF40/EE/EEM	70	0.35	350	105	5	2LF28/HE/LBF	42	0.2	210	1000		0	0	0.1	140	0.00	0	0.00	140
17	Main Garage	4	17	2X4-PARA-4LF40/EE/EEM	140	2.38	5950	102	17	4LF28/HE/LBF	82	1.4	3485	2500		0	0	1.0	2465	0.00	0	0.00	2465
18	Main Garage	68	4	Metal Halide-1L/250W	290	1.16	2900	169	4	3L-T5/HO/N	177	0.7	1770	2500		4	0	0.5	1130	0.00	443	0.00	1573
19	Rm 224	4	4	2X4-PARA-4LF40/EE/EEM	140	0.56	1400	102	4	4LF28/HE/LBF	82	0.3	820	2500		1	0	0.2	580	0.00	205	0.00	785
20	Rm 225	24	3	4'-IND-2LF40/EE/EEM	70	0.21	525	105	3	2LF28/HE/LBF	42	0.1	315	2500		0	0	0.1	210	0.00	0	0.00	210
21	Rm 226	24	2	4'-IND-2LF40/EE/EEM	70	0.14	350	105	2	2LF28/HE/LBF	42	0.1	210	2500		0	0	0.1	140	0.00	0	0.00	140
22	Exterior	76	16	70W HPS WALL PACK	90	1.44	5760	100	16	NO-RETRO	90	1.4	5760	4000		0	0	0.0	0	0.00	0	0.00	0
23				0	0	0.00	0		0	0	#N/A	0.0	0	2500		0	0	0.0	0	0.00	0	0.00	0
TOTALS		114			11.55	26692.00		114			8.73	20554.00			15	1	2.82	6138.00	0.00	1348.00	0.00	7486.00	

MATERIAL & LABOR

**Town of Concord**  
**Water & Sewer Division**  
**ECM: Lighting Improvements**  
MATERIAL AND LABOR BREAKDOWN

REPLACEMENT MATERIAL	QUANTITY	MATERIAL COST	LABOR COST	TOTAL MATERIAL	TOTAL LABOR	TOTAL RAW COST
NO-RETRO	58	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
4LF28/HE/LBF	28	\$26.00	\$35.00	\$728.00	\$980.00	\$1,708
4LF28/HE/NBF	0	\$26.00	\$35.00	\$0.00	\$0.00	\$0
3LF28/HE/LBF	4	\$24.00	\$35.00	\$96.00	\$140.00	\$236
2LF28/HE/LBF	20	\$22.00	\$35.00	\$440.00	\$700.00	\$1,140
1LF28/HE/LBF	0	\$20.00	\$35.00	\$0.00	\$0.00	\$0
8'-2LF28/HE/LBF	0	\$22.00	\$35.00	\$0.00	\$0.00	\$0
12'-3LF28/HE/LBF	0	\$28.00	\$40.00	\$0.00	\$0.00	\$0
14'-4LF28/HE/LBF	0	\$30.00	\$50.00	\$0.00	\$0.00	\$0
8'-4LF28/HE/LBF	0	\$30.00	\$35.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
1LF17/HE/LBF	0	\$15.00	\$35.00	\$0.00	\$0.00	\$0
2LF17/HE/LBF	0	\$19.00	\$35.00	\$0.00	\$0.00	\$0
1LF25/HE/LBF	0	\$16.00	\$35.00	\$0.00	\$0.00	\$0
2LF25/HE/LBF	0	\$22.00	\$35.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
2LFB30/HE/LBF	0	\$27.00	\$35.00	\$0.00	\$0.00	\$0
4'-1LF28/HE/NBF/WR/N	0	\$50.00	\$75.00	\$0.00	\$0.00	\$0
8'-2LF28/HE/NBF/WR/N	0	\$70.00	\$75.00	\$0.00	\$0.00	\$0
12'-3LF28/HE/NBF/WR/N	0	\$95.00	\$125.00	\$0.00	\$0.00	\$0
16'-4LF28/HE/NBF/WR/N	0	\$125.00	\$175.00	\$0.00	\$0.00	\$0
4'-2LF28/HE/NBF/WR/N	0	\$60.00	\$75.00	\$0.00	\$0.00	\$0
8'-4LF28/HE/LBF/WR/N	0	\$75.00	\$75.00	\$0.00	\$0.00	\$0
4'-1LF28/HE/NBF/IND/N	0	\$50.00	\$75.00	\$0.00	\$0.00	\$0
8'-2LF28/HE/NBF/IND/N	0	\$75.00	\$75.00	\$0.00	\$0.00	\$0
12'-3LF28/HE/NBF/IND/N	0	\$95.00	\$125.00	\$0.00	\$0.00	\$0
16'-4LF28/HE/NBF/IND/N	0	\$125.00	\$175.00	\$0.00	\$0.00	\$0
4'-2LF28/HE/NBF/IND/N	0	\$60.00	\$75.00	\$0.00	\$0.00	\$0
8'-4LF28/HE/LBF/IND/N	0	\$75.00	\$75.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
4'-1LF28/HE/NBF/ST/N	0	\$45.00	\$75.00	\$0.00	\$0.00	\$0
8'-2LF28/HE/NBF/ST/N	0	\$65.00	\$75.00	\$0.00	\$0.00	\$0
12'-3LF28/HE/NBF/ST/N	0	\$90.00	\$125.00	\$0.00	\$0.00	\$0
16'-4LF28/HE/NBF/WST/N	0	\$120.00	\$175.00	\$0.00	\$0.00	\$0
4'-1LF28/HE/NBF/WWR/N	0	\$70.00	\$75.00	\$0.00	\$0.00	\$0
8'-2LF28/HE/NBF/WWR/N	0	\$90.00	\$75.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
15W CF/SI	0	\$9.00	\$10.00	\$0.00	\$0.00	\$0
23W CF/SI	0	\$9.00	\$10.00	\$0.00	\$0.00	\$0
1X4-1LF28/HE/NBF/N	0	\$75.00	\$75.00	\$0.00	\$0.00	\$0
2X4-2LF28/HE/NBF/N	0	\$80.00	\$75.00	\$0.00	\$0.00	\$0
2L-13W CF/HW	0	\$25.00	\$40.00	\$0.00	\$0.00	\$0
1L-13W CF/HW	0	\$22.00	\$40.00	\$0.00	\$0.00	\$0
REMOVE & CAP	0	\$10.00	\$50.00	\$0.00	\$0.00	\$0

MATERIAL & LABOR

**Town of Concord  
Water & Sewer Division  
ECM: Lighting Improvements**

**MATERIAL AND LABOR BREAKDOWN**

NEW LED EXIT	0	\$20.00	\$60.00	\$0.00	\$0.00	\$0
1L-13W CF/HW/JAR	0	\$45.00	\$40.00	\$0.00	\$0.00	\$0
175W MH/LB	0	\$175.00	\$200.00	\$0.00	\$0.00	\$0
250W MH/LB	0	\$200.00	\$200.00	\$0.00	\$0.00	\$0
250W MH/HB	0	\$200.00	\$200.00	\$0.00	\$0.00	\$0
400W MH/HB	0	\$275.00	\$200.00	\$0.00	\$0.00	\$0
35W HPS WALL PACK	0	\$95.00	\$125.00	\$0.00	\$0.00	\$0
70W HPS WALL PACK	0	\$95.00	\$125.00	\$0.00	\$0.00	\$0
35W HPS CANOPY	0	\$110.00	\$125.00	\$0.00	\$0.00	\$0
70W HPS CANOPY	0	\$110.00	\$125.00	\$0.00	\$0.00	\$0
35W HPS MINI-FLOOD	0	\$95.00	\$125.00	\$0.00	\$0.00	\$0
70W HPS MINI-FLOOD	0	\$95.00	\$125.00	\$0.00	\$0.00	\$0
150W HPS/FLOOD	0	\$195.00	\$175.00	\$0.00	\$0.00	\$0
250W HPS/FLOOD	0	\$195.00	\$175.00	\$0.00	\$0.00	\$0
400W HPS/FLOOD	0	\$195.00	\$175.00	\$0.00	\$0.00	\$0
100W HPS/LB	0	\$175.00	\$200.00	\$0.00	\$0.00	\$0
150W HPS/LB	0	\$195.00	\$200.00	\$0.00	\$0.00	\$0
4L-T5/HO/N	0	\$225.00	\$250.00	\$0.00	\$0.00	\$0
3L-T5/HO/N	4	\$200.00	\$250.00	\$800.00	\$1,000.00	\$1,800
2L-T5/HO/N	0	\$160.00	\$250.00	\$0.00	\$0.00	\$0
4L-T8/HP/N	0	\$130.00	\$150.00	\$0.00	\$0.00	\$0
3L-T8/HP/N	0	\$125.00	\$150.00	\$0.00	\$0.00	\$0
2L-T8/HP/N	0	\$90.00	\$150.00	\$0.00	\$0.00	\$0
1LF59/LBF	0	\$30.00	\$30.00	\$0.00	\$0.00	\$0
2LF59/LBF	0	\$35.00	\$30.00	\$0.00	\$0.00	\$0

**TOTALS :** 114 \$2,064.00 \$2,820.00 \$4,884.00

<b>HAZARDOUS WASTE</b>	<b>\$195.38</b>
<b>LIGHTING RAW COST</b>	
<b>TOTAL</b>	<b>\$5,079.38</b>

SIMPLE PAYBACK
10.39

OCCUPANCY SENSORS	QUANTITY	MATERIAL COST	LABOR COST	TOTAL MATERIAL	TOTAL LABOR	TOTAL RAW COST
SWITCH MOUNT	15	\$ 50.00	\$ 35.00	\$750.00	\$525.00	\$1,275.00
CEILING MOUNT	1	\$ 110.00	\$ 150.00	\$110.00	\$150.00	\$260.00

**TOTALS :** 16 \$860.00 \$675.00 \$1,535.00

C:\Documents and Settings\Owner\Desktop\Concord New\Concord Lighting Revised\Water & Sewer lighting 2.xls]EXISTING MAT.



## CODES

EXIST CODE	FIXTURE TYPE	WATTS	# OF LAMPS	# OF BALS.	REPL. CODE	PROPOSED FIXTURE	WATTS	MAT. COST	LABOR COST	# OF BALS.	# OF LAMPS
1	2X4-ACRY-4LF40/EE/EEM	140	4	2	100	NO-RETRO	0	0	0	0	0
2	2X4-ACRY-3LF40/EE/EEM	110	3	2	101						
3	2X4-ACRY-2LF40/EE/EEM	70	2	1	102	4LF28/HE/LBF	82	26	35	1	2
4	2X4-PARA-4LF40/EE/EEM	140	4	2	103	4LF28/HE/NBF	93	26	35	1	4
5	2X4-PARA-3LF40/EE/EEM	110	3	2	104	3LF28/HE/LBF	63	24	35	1	3
6	2X4-PARA-2LF40/EE/EEM	70	2	1	105	2LF28/HE/LBF	42	22	35	1	2
7	1X4-PARA-2LF40/EE/EEM	70	2	1	106	1LF28/HE/LBF	23	20	35	1	1
8	1X4-ACRY-2LF40/EE/EEM	70	2	1	107	8'-2LF28/HE/LBF	42	22	35	1	2
9	2X2-PARA-2LFB40/ES/EEM	70	2	1	108	12'-3LF28/HE/LBF	63	28	40	1	3
10	2X2-ACRY-2LFB40/ES/EEM	70	2	1	109	14'-4LF28/HE/LBF	82	30	50	1	4
11	2X2-ACRY-4LF20/ES/STD	112	4	2	110	8'-4LF28/HE/LBF	82	30	35	1	4
12	4'-WRAP-1LF40/EE/EEM	40	1	1	111						
13	4'-WRAP-2LF40/EE/EEM	70	2	1	112						
14	4'-WRAP-3LF40/EE/EEM	110	3	2	113						
15	4'-WRAP-4LF40/EE/EEM	140	4	2	114						
16	2'-WALL WR-2LF20/EEM/STD	56	2	1	115	1LF17/HE/LBF	15	15	35	1	1
17	4'-WALL WR-1LF40/EE/EEM	40	1	1	116	2LF17/HE/LBF	27	19	35	1	2
18	4'-WALL WR-2LF40/EE/EEM	70	2	1	117	1LF25/HE/LBF	20	16	35	1	1
19	4'-DAMP WR-1LF40/EE/EEM	40	1	1	118	2LF25/HE/LBF	39	22	35	1	2
20	8'-DAMP WR-1LF96/EE/EEM	83	1	1	119						
21	8'-DAMP WR-2LF96/EE/EEM	123	2	1	120						
22	8'-WRAP-4LF40/EE/EEM	140	4	2	121						
23	4'-IND-1LF40/EE/EEM	40	1	1	122	2LFB30/HE/LBF	45	27	35	1	2
24	4'-IND-2LF40/EE/EEM	70	2	1	123	4'-1LF28/HE/NBF/WR/N	25	50	75	1	1
25	4'-IND-3LF40/EE/EEM	110	3	2	124	8'-2LF28/HE/NBF/WR/N	47	70	75	1	2
26	4'-IND-4LF40/EE/EEM	140	4	2	125	12'-3LF28/HE/NBF/WR/N	72	95	125	1	3
27	4'-IND-2LF40/HO/STD	145	2	1	126	16'-4LF28/HE/NBF/WR/N	94	125	175	1	4
28	8'-IND-4LF40/EE/EEM	140	4	2	127	4'-2LF28/HE/NBF/WR/N	47	60	75	1	2
29	8'-IND-2LF96/EE/EEM	123	2	1	128	8'-4LF28/HE/LBF/WR/N	82	75	75	1	4
30	8'-IND-3LF96/EE/EEM	206	3	2	129	4'-1LF28/HE/NBF/IND/N	25	50	75	1	1
31	8'-IND-2LF96/HO/STD	227	2	1	130	8'-2LF28/HE/NBF/IND/N	47	75	75	1	2
32	8'-IND-4LF96/HO/STD	454	4	2	131	12'-3LF28/HE/NBF/IND/N	72	95	125	1	3
33	2'-STR-1LF20/EEM/STD	32	1	1	132	16'-4LF28/HE/NBF/IND/N	94	125	175	1	4
34	3'-STR-1LF30/EEM/STD	46	1	1	133	4'-2LF28/HE/NBF/IND/N	47	60	75	1	2
35	3'-STR-2LF30/EEM/STD	80	2	1	134	8'-4LF28/HE/LBF/IND/N	82	75	75	1	4
36	4'-STR-1LF40/EE/EEM	40	1	1	135						
37	4'-STR-2LF40/EE/EEM	70	2	1	136	4'-1LF28/HE/NBF/ST/N	25	45	75	1	1
38	8'-STR-2LF40/EE/EEM	70	2	1	137	8'-2LF28/HE/NBF/ST/N	47	65	75	1	2
39	8'-STR-1LF96/EE/EEM	83	1	1	138	12'-3LF28/HE/NBF/ST/N	72	90	125	1	3
40	8'-STR-2LF96/EE/EEM	123	2	1	139	16'-4LF28/HE/NBF/WST/N	94	120	175	1	4
41	4'-ICE TRAY-2LF40/EE/EEM	70	2	1	140	4'-1LF28/HE/NBF/WWR/N	25	70	75	1	1
42	8'-ICE TRAY-4LF40/EE/EEM	140	4	2	141	8'-2LF28/HE/NBF/WWR/N	47	90	75	1	2
43	4'-ICE TRAY-4LF40/EE/EEM	140	4	2	142						
44	8'-ICE TRAY-2LF96/EE/EEM	123	2	1	143						
45	8'-ICE TRAY-4LF96/EE/EEM	246	4	2	144	15W CF/SI	15	9	10	0	1
46	4'-BOX-2LF40/EE/EEM	70	2	1	145	23W CF/SI	23	9	10	0	1
47	4'-BOX-3LF40/EE/EEM	110	4	2	146	1X4-1LF28/HE/NBF/N	25	75	75	1	1

## CODES

[illegible]

Town of Concord  
Beede Center  
ECM: Lighting Improvements

\$/kWh 0.085  
\$/kW -

Location		Existing Conditions						Retrofit Conditions								Sensors		Retrofit Savings		Sensor Savings		Total Savings	
Item #	Room #	Code	# Of Fxts	Existing Fixture	Watts	kW	kWh	Code	# Of Fxts	Replacement Fixture	Watts	kW	kWh	H (h/yr)	FC	High Lo	Ceil Mt.	kW Saved	kWh Saved	kW Saved	kWh Saved	Demand kW Reduction	kWh/year Saved
1	north exercise rm	74	16	2x2-2LFT36	55	0.88	4400	100	16	NO-RETRO	55	0.9	4400	5000		0	0	1.0	0	0.00	0	0.00	0
2	office	74	2	2x2-2LFT36	55	0.11	550	100	2	NO-RETRO	55	0.1	550	5000		0	0	0.0	0	0.00	0	0.00	0
3	stock rm	74	2	2x2-2LFT36	55	0.11	550	100	2	NO-RETRO	55	0.1	550	5000		0	0	0.0	0	0.00	0	0.00	0
4	south exercise rm	74	16	2x2-2LFT36	55	0.88	4400	100	16	NO-RETRO	55	0.9	4400	5000		0	0	0.0	0	0.00	0	0.00	0
5	office	75	2	2L-13W CF	30	0.06	300	100	2	NO-RETRO	30	0.1	300	5000		0	0	0.0	0	0.00	0	0.00	0
6	office	75	2	2L-13W CF	30	0.06	300	100	2	NO-RETRO	30	0.1	300	5000		0	0	0.0	0	0.00	0	0.00	0
7	front lobby	75	33	2L-13W CF	30	0.99	4950	100	33	NO-RETRO	30	1.0	4950	5000		0	0	0.0	0	0.00	0	0.00	0
8	snack bar	75	6	2L-13W CF	30	0.18	900	100	6	NO-RETRO	30	0.2	900	5000		0	0	0.0	0	0.00	0	0.00	0
9	side office	75	6	2L-13W CF	30	0.18	900	100	6	NO-RETRO	30	0.2	900	5000		0	0	0.0	0	0.00	0	0.00	0
10	mech rms	73	24	2LF32/T8	60	1.44	7200	100	24	NO-RETRO	60	1.4	7200	5000		0	0	0.0	0	0.00	0	0.00	0
11	mens lockers	70	10	2X4-3LF32/T8	88	0.88	4400	100	10	NO-RETRO	88	0.9	4400	5000		0	0	0.0	0	0.00	0	0.00	0
12	mens lockers	73	6	2LF32/T8	60	0.36	1800	100	6	NO-RETRO	60	0.4	1800	5000		0	0	0.0	0	0.00	0	0.00	0
13	womens lockers	70	10	2X4-3LF32/T8	88	0.88	4400	100	10	NO-RETRO	88	0.9	4400	5000		0	0	0.0	0	0.00	0	0.00	0
14	womens lockers	73	6	2LF32/T8	60	0.36	1800	100	6	NO-RETRO	60	0.4	1800	5000		0	0	0.0	0	0.00	0	0.00	0
15	misc lower level offices	70	26	2X4-3LF32/T8	88	2.29	11440	100	26	NO-RETRO	88	2.3	11440	5000		0	0	0.0	0	0.00	0	0.00	0
16	lower level hall	74	14	2x2-2LFT36	55	0.77	3850	100	14	NO-RETRO	55	0.8	3850	5000		0	0	0.0	0	0.00	0	0.00	0
17	pool	63	24	1000W Metal Halide	1100	26.40	132000	100	24	NO-RETRO	1100	26.4	132000	5000		24	0	0.0	0	0.00	26400	0.00	26400
18	pool	61	32	175W Metal Halide	205	6.56	32800	100	32	NO-RETRO	205	6.6	32800	5000		0	0	0.0	0	0.00	0	0.00	0
19	pool storage	73	7	2LF32/T8	60	0.42	2100	100	7	NO-RETRO	60	0.4	2100	5000		0	0	0.0	0	0.00	0	0.00	0
TOTALS		244				43.81	219040.00	244				43.81	219040.00			24	0	1.00	0.00	0.00	26400.00	0.00	26400.00

MATERIAL & LABOR

**Town of Concord**  
**Beede Center**  
**ECM: Lighting Improvements**  
MATERIAL AND LABOR BREAKDOWN

REPLACEMENT MATERIAL	QUANTITY	MATERIAL COST	LABOR COST	TOTAL MATERIAL	TOTAL LABOR	TOTAL RAW COST
NO-RETRO	125	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
4LF28/HE/LBF	0	\$26.00	\$35.00	\$0.00	\$0.00	\$0
4LF28/HE/NBF	0	\$26.00	\$35.00	\$0.00	\$0.00	\$0
3LF28/HE/LBF	0	\$24.00	\$35.00	\$0.00	\$0.00	\$0
2LF28/HE/LBF	0	\$22.00	\$35.00	\$0.00	\$0.00	\$0
1LF28/HE/LBF	0	\$20.00	\$35.00	\$0.00	\$0.00	\$0
8'-2LF28/HE/LBF	0	\$22.00	\$35.00	\$0.00	\$0.00	\$0
12'-3LF28/HE/LBF	0	\$28.00	\$40.00	\$0.00	\$0.00	\$0
14'-4LF28/HE/LBF	0	\$30.00	\$50.00	\$0.00	\$0.00	\$0
8'-4LF28/HE/LBF	0	\$30.00	\$35.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
1LF17/HE/LBF	0	\$15.00	\$35.00	\$0.00	\$0.00	\$0
2LF17/HE/LBF	0	\$19.00	\$35.00	\$0.00	\$0.00	\$0
1LF25/HE/LBF	0	\$16.00	\$35.00	\$0.00	\$0.00	\$0
2LF25/HE/LBF	0	\$22.00	\$35.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
2LFB30/HE/LBF	0	\$27.00	\$35.00	\$0.00	\$0.00	\$0
4'-1LF28/HE/NBF/WR/N	0	\$50.00	\$75.00	\$0.00	\$0.00	\$0
8'-2LF28/HE/NBF/WR/N	0	\$70.00	\$75.00	\$0.00	\$0.00	\$0
12'-3LF28/HE/NBF/WR/N	0	\$95.00	\$125.00	\$0.00	\$0.00	\$0
16'-4LF28/HE/NBF/WR/N	0	\$125.00	\$175.00	\$0.00	\$0.00	\$0
4'-2LF28/HE/NBF/WR/N	0	\$60.00	\$75.00	\$0.00	\$0.00	\$0
8'-4LF28/HE/LBF/WR/N	0	\$75.00	\$75.00	\$0.00	\$0.00	\$0
4'-1LF28/HE/NBF/IND/N	0	\$50.00	\$75.00	\$0.00	\$0.00	\$0
8'-2LF28/HE/NBF/IND/N	0	\$75.00	\$75.00	\$0.00	\$0.00	\$0
12'-3LF28/HE/NBF/IND/N	0	\$95.00	\$125.00	\$0.00	\$0.00	\$0
16'-4LF28/HE/NBF/IND/N	0	\$125.00	\$175.00	\$0.00	\$0.00	\$0
4'-2LF28/HE/NBF/IND/N	0	\$60.00	\$75.00	\$0.00	\$0.00	\$0
8'-4LF28/HE/LBF/IND/N	0	\$75.00	\$75.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
4'-1LF28/HE/NBF/ST/N	0	\$45.00	\$75.00	\$0.00	\$0.00	\$0
8'-2LF28/HE/NBF/ST/N	0	\$65.00	\$75.00	\$0.00	\$0.00	\$0
12'-3LF28/HE/NBF/ST/N	0	\$90.00	\$125.00	\$0.00	\$0.00	\$0
16'-4LF28/HE/NBF/WST/N	0	\$120.00	\$175.00	\$0.00	\$0.00	\$0
4'-1LF28/HE/NBF/WWR/N	0	\$70.00	\$75.00	\$0.00	\$0.00	\$0
8'-2LF28/HE/NBF/WWR/N	0	\$90.00	\$75.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
30W CF/SI	0	\$9.00	\$0.00	\$0.00	\$0.00	\$0
14W CF/SI	0	\$9.00	\$10.00	\$0.00	\$0.00	\$0
23W CF/SI	0	\$9.00	\$10.00	\$0.00	\$0.00	\$0
1X4-1LF28/HE/NBF/N	0	\$75.00	\$75.00	\$0.00	\$0.00	\$0
2X4-2LF28/HE/NBF/N	0	\$80.00	\$75.00	\$0.00	\$0.00	\$0
2L-13W CF/HW	0	\$25.00	\$40.00	\$0.00	\$0.00	\$0
1L-13W CF/HW	0	\$22.00	\$40.00	\$0.00	\$0.00	\$0
REMOVE & CAP	0	\$10.00	\$50.00	\$0.00	\$0.00	\$0

MATERIAL & LABOR

**Town of Concord**  
**Beede Center**  
**ECM: Lighting Improvements**

**MATERIAL AND LABOR BREAKDOWN**

NEW LED EXIT	0	\$20.00	\$60.00	\$0.00	\$0.00	\$0
1L-13W CF/HW/JAR	0	\$45.00	\$40.00	\$0.00	\$0.00	\$0
175W MH/LB	0	\$175.00	\$200.00	\$0.00	\$0.00	\$0
250W MH/LB	0	\$200.00	\$200.00	\$0.00	\$0.00	\$0
250W MH/HB	0	\$200.00	\$200.00	\$0.00	\$0.00	\$0
400W MH/HB	0	\$275.00	\$200.00	\$0.00	\$0.00	\$0
35W HPS WALL PACK	0	\$95.00	\$125.00	\$0.00	\$0.00	\$0
70W HPS WALL PACK	0	\$95.00	\$125.00	\$0.00	\$0.00	\$0
35W HPS CANOPY	0	\$110.00	\$125.00	\$0.00	\$0.00	\$0
70W HPS CANOPY	0	\$110.00	\$125.00	\$0.00	\$0.00	\$0
35W HPS MINI-FLOOD	0	\$95.00	\$125.00	\$0.00	\$0.00	\$0
70W HPS MINI-FLOOD	0	\$95.00	\$125.00	\$0.00	\$0.00	\$0
150W HPS/FLOOD	0	\$195.00	\$175.00	\$0.00	\$0.00	\$0
250W HPS/FLOOD	0	\$195.00	\$175.00	\$0.00	\$0.00	\$0
400W HPS/FLOOD	0	\$195.00	\$175.00	\$0.00	\$0.00	\$0
100W HPS/LB	0	\$175.00	\$200.00	\$0.00	\$0.00	\$0
150W HPS/LB	0	\$195.00	\$200.00	\$0.00	\$0.00	\$0
4L-T5/HO/N	0	\$200.00	\$250.00	\$0.00	\$0.00	\$0
3L-T5/HO/N	0	\$175.00	\$250.00	\$0.00	\$0.00	\$0
2L-T5/HO/N	0	\$135.00	\$250.00	\$0.00	\$0.00	\$0
4L-T8/HP/N	0	\$130.00	\$150.00	\$0.00	\$0.00	\$0
3L-T8/HP/N	0	\$125.00	\$150.00	\$0.00	\$0.00	\$0
2L-T8/HP/N	0	\$90.00	\$150.00	\$0.00	\$0.00	\$0
1LF59/LBF	0	\$30.00	\$30.00	\$0.00	\$0.00	\$0
2LF59/LBF	0	\$35.00	\$30.00	\$0.00	\$0.00	\$0
2L-T8/HP/N	0	\$90.00	\$150.00	\$0.00	\$0.00	\$0
1LF59/LBF	0	\$30.00	\$30.00	\$0.00	\$0.00	\$0
2LF59/LBF	0	\$35.00	\$30.00	\$0.00	\$0.00	\$0

**TOTALS :** **125** **\$0.00** **\$0.00** **\$0.00**

<b>HAZARDOUS WASTE</b>	<b>\$182.00</b>
<b>LIGHTING RAW COST</b>	<b>\$182.00</b>
<b>TOTAL</b>	<b>\$182.00</b>

SIMPLE PAYBACK
4.09

<b>OCCUPANCY SENSORS</b>	<b>QUANTITY</b>	<b>MATERIAL COST</b>	<b>LABOR COST</b>	<b>TOTAL MATERIAL</b>	<b>TOTAL LABOR</b>	<b>TOTAL RAW COST</b>
High Low Controls	24	\$ 175.00	\$ 200.00	\$4,200.00	\$4,800.00	\$9,000.00
CEILING MOUNT	0	\$ 110.00	\$ 150.00	\$0.00	\$0.00	\$0.00

**TOTALS :** **24** **\$4,200.00** **\$4,800.00** **\$9,000.00**

C:\Documents and Settings\Owner\Desktop\Concord New\Concord Lighting Revised\Beede lighting 2.xls]EXISTING MAT.



## CODES

EXIST CODE	FIXTURE TYPE	WATTS	# OF LAMPS	# OF BALS.	REPL. CODE	PROPOSED FIXTURE	WATTS	MAT. COST	LABOR COST	# OF BALS.	# OF LAMPS
1	2X4-4LF40/EE/EEM	140	4	2	100	NO-RETRO	0	0	0	0	0
2	2X4-3LF40/EE/EEM	110	3	2	101						
3	2X4-2LF40/EE/EEM	70	2	1	102	4LF28/HE/LBF	82	26	35	1	2
4	1X4-2LF40/EE/EEM	70	2	1	103	4LF28/HE/NBF	93	26	35	1	4
5					104	3LF28/HE/LBF	63	24	35	1	3
6	2X2-2LFB40/ES/EEM	70	2	1	105	2LF28/HE/LBF	42	22	35	1	2
7	2X2-4LF20/ES/STD	112	4	2	106	1LF28/HE/LBF	23	20	35	1	1
8					107	8'-2LF28/HE/LBF	42	22	35	1	2
9	4'-WRAP-1LF40/EE/EEM	40	1	1	108	12'-3LF28/HE/LBF	63	28	40	1	3
10	4'-WRAP-2LF40/EE/EEM	70	2	1	109	14'-4LF28/HE/LBF	82	30	50	1	4
11	4'-WRAP-3LF40/EE/EEM	110	3	2	110	8'-4LF28/HE/LBF	82	30	35	1	4
12	4'-WRAP-4LF40/EE/EEM	140	4	2	111						
13	2'-WALL WR-2LF20/EEM/STD	56	2	1	112						
14	4'-WALL WR-1LF40/EE/EEM	40	1	1	113						
15	4'-WALL WR-2LF40/EE/EEM	70	2	1	114						
16	4'-DAMP WR-1LF40/EE/EEM	40	1	1	115	1LF17/HE/LBF	15	15	35	1	1
17	8'-DAMP WR-1LF96/EE/EEM	83	1	1	116	2LF17/HE/LBF	27	19	35	1	2
18	8'-DAMP WR-2LF96/EE/EEM	123	2	1	117	1LF25/HE/LBF	20	16	35	1	1
19	8'-WRAP-4LF40/EE/EEM	140	4	2	118	2LF25/HE/LBF	39	22	35	1	2
20	4'-IND-1LF40/EE/EEM	40	1	1	119						
21	4'-IND-2LF40/EE/EEM	70	2	1	120						
22	4'-IND-3LF40/EE/EEM	110	3	2	121						
23	4'-IND-4LF40/EE/EEM	140	4	2	122	2LFB30/HE/LBF	45	27	35	1	2
24	4'-IND-2LF40/HO/STD	145	2	1	123	4'-1LF28/HE/NBF/WR/N	25	50	75	1	1
25	8'-IND-4LF40/EE/EEM	140	4	2	124	8'-2LF28/HE/NBF/WR/N	47	70	75	1	2
26	8'-IND-2LF96/EE/EEM	123	2	1	125	12'-3LF28/HE/NBF/WR/N	72	95	125	1	3
27	8'-IND-3LF96/EE/EEM	206	3	2	126	16'-4LF28/HE/NBF/WR/N	94	125	175	1	4
28	8'-IND-2LF96/HO/STD	227	2	1	127	4'-2LF28/HE/NBF/WR/N	47	60	75	1	2
29	8'-IND-4LF96/HO/STD	454	4	2	128	8'-4LF28/HE/LBF/WR/N	82	75	75	1	4
30	2'-STR-1LF20/EEM/STD	32	1	1	129	4'-1LF28/HE/NBF/IND/N	25	50	75	1	1
31	3'-STR-1LF30/EEM/STD	46	1	1	130	8'-2LF28/HE/NBF/IND/N	47	75	75	1	2
32	3'-STR-2LF30/EEM/STD	80	2	1	131	12'-3LF28/HE/NBF/IND/N	72	95	125	1	3
33	4'-STR-1LF40/EE/EEM	40	1	1	132	16'-4LF28/HE/NBF/IND/N	94	125	175	1	4
34	4'-STR-2LF40/EE/EEM	70	2	1	133	4'-2LF28/HE/NBF/IND/N	47	60	75	1	2
35	8'-STR-2LF40/EE/EEM	70	2	1	134	8'-4LF28/HE/LBF/IND/N	82	75	75	1	4
36	8'-STR-1LF96/EE/EEM	83	1	1	135						
37	8'-STR-2LF96/EE/EEM	123	2	1	136	4'-1LF28/HE/NBF/ST/N	25	45	75	1	1
38	4'-ICE TRAY-2LF40/EE/EEM	70	2	1	137	8'-2LF28/HE/NBF/ST/N	47	65	75	1	2
39	8'-ICE TRAY-4LF40/EE/EEM	140	4	2	138	12'-3LF28/HE/NBF/ST/N	72	90	125	1	3
40	4'-ICE TRAY-1LF40/EE/EEM	40	1	1	139	16'-4LF28/HE/NBF/WST/N	94	120	175	1	4
41	8'-ICE TRAY-2LF96/EE/EEM	123	2	1	140	4'-1LF28/HE/NBF/WWR/N	25	70	75	1	1
42	8'-ICE TRAY-4LF96/EE/EEM	246	4	2	141	8'-2LF28/HE/NBF/WWR/N	47	90	75	1	2
43	4'-BOX-2LF40/EE/EEM	70	2	1	142						
44	4'-BOX-3LF40/EE/EEM	110	4	2	143	30W CF/SI	30	9		0	1
45					144	14W CF/SI	14	9	10	0	1
46					145	23W CF/SI	23	9	10	0	1
47	INCAND-1L/60W	60	1	0	146	1X4-1LF28/HE/NBF/N	25	75	75	1	1

CODES

61	175W Metal Halide	205	1	1	160	70W HPS CANOPY	90	110	125	1	1
62	250W Metal Halide	290	1	1	161	35W HPS MINI-FLOOD	50	95	125	1	1
63	1000W Metal Halide	1100	1	1	162	70W HPS MINI-FLOOD	90	95	125	1	1
64	70W HPS	90	1	1	163	150W HPS/FLOOD	190	195	175	1	1
65	150W HPS	190	1	1	164	250W HPS/FLOOD	295	195	175	1	1
66	250W HPS	290	1	1	165	400W HPS/FLOOD	460	195	175	1	1
67	400W HPS	455	1	1	166	100W HPS/LB	120	175	200	1	1
68					167	150W HPS/LB	190	195	200	1	1
69	2X4-4LF32/T8	120	4	1	168	4L-T5/HO/N	234	200	250	2	4
70	2X4-3LF32/T8	88	3	1	169	3L-T5/HO/N	177	175	250	2	3
71	2X4-2LF32/T8	60	2	1	170	2L-T5/HO/N	117	135	250	1	2
72	2x2-2LFB30/T8	45	2	1	171	4L-T8/HP/N	156	130	150	1	4
73	2LF32/T8	60	2	1	172	3L-T8/HP/N	112	125	150	1	3
74	2x2-2LFT36	55	2	1	173	2L-T8/HP/N	78	90	150	1	2
75	2L-13W CF	30	2	2	174	1LF59/LBF	57	30	30	1	1
76					175	2LF59/LBF	100	35	30	1	2
77					176						
78					177						

Town of Concord  
Hunt Recreation Facility  
ECM: Lighting Improvements

\$/kWh 0.085  
\$/kW -

Location		Existing Conditions						Retrofit Conditions								Sensors		Retrofit Savings		Sensor Savings		Total Savings							
Item #	Room #	Code	# Of Fxts	Existing Fixture	Watts	kW	kWh	Code	# Of Fxts	Replacement Fixture	Watts	kW	kWh	H (h/yr)	FC	Sw Mt.	Ceil Mt.	kW Saved	kWh Saved	kW Saved	kWh Saved	Demand kW Reduction	kWh/year Saved						
1	main entry	47	2	INCAND-1L/60W	60	0.12	300	144	2	14W CF/SI	14	0.0	70	2500		0	0	0.1	230	0.00	0	0.00	230						
2	main reception	47	15	INCAND-1L/60W	60	0.90	2250	144	15	14W CF/SI	14	0.2	525	2500		0	0	0.7	1725	0.00	0	0.00	1725						
3	Conf rm	73	8	2LF32/T8	60	0.48	240	100	8	NO-RETRO	60	0.5	240	500		0	1	0.0	0	0.00	60	0.00	60						
4	main office	73	4	2LF32/T8	60	0.24	600	100	4	NO-RETRO	60	0.2	600	2500		1	0	0.0	0	0.00	150	0.00	150						
5	sm office	73	2	2LF32/T8	60	0.12	240	100	2	NO-RETRO	60	0.1	240	2000		1	0	0.0	0	0.00	60	0.00	60						
6	sm office	73	2	2LF32/T8	60	0.12	240	100	2	NO-RETRO	60	0.1	240	2000		1	0	0.0	0	0.00	60	0.00	60						
7	sm kitchen	73	1	2LF32/T8	60	0.06	120	100	1	NO-RETRO	60	0.1	120	2000		0	0	0.0	0	0.00	0	0.00	0						
8	hall	73	7	2LF32/T8	60	0.42	1050	100	7	NO-RETRO	60	0.4	1050	2500		0	0	0.0	0	0.00	0	0.00	0						
9	multi-purpose	73	37	2LF32/T8	60	2.22	5550	100	37	NO-RETRO	60	2.2	5550	2500		0	0	0.0	0	0.00	0	0.00	0						
10	storage	73	3	2LF32/T8	60	0.18	90	100	3	NO-RETRO	60	0.2	90	500		1	0	0.0	0	0.00	23	0.00	23						
11	men's lockers	73	7	2LF32/T8	60	0.42	1050	100	7	NO-RETRO	60	0.4	1050	2500		0	0	0.0	0	0.00	0	0.00	0						
12	women's lockers	73	7	2LF32/T8	60	0.42	1050	100	7	NO-RETRO	60	0.4	1050	2500		0	0	0.0	0	0.00	0	0.00	0						
13	stairwell	47	2	INCAND-1L/60W	60	0.12	300	144	2	14W CF/SI	14	0.0	70	2500		0	0	0.1	230	0.00	0	0.00	230						
14	exercise rm	73	7	2LF32/T8	60	0.42	1050	100	7	NO-RETRO	60	0.4	1050	2500		0	0	0.0	0	0.00	0	0.00	0						
15	gym	63	16	400W Metal Halide	455	7.28	25480	168	16	4L-T5/HO/N	234	3.7	13104	3500		16	0	3.5	12376	0.00	3276	0.00	15652						
16				0	0	0.00	0		0	0	#N/A	0.0	0	2500		0	0	0.0	0	0.00	0	0.00	0						
TOTALS		120		13.52		39610.00		32		9.11		25049		20		1		4.41		14561		0.00		3629		0.00		18190	

MATERIAL & LABOR

**Town of Concord**  
**Hunt Recreation Facility**  
**ECM: Lighting Improvements**  
MATERIAL AND LABOR BREAKDOWN

REPLACEMENT MATERIAL	QUANTITY	MATERIAL COST	LABOR COST	TOTAL MATERIAL	TOTAL LABOR	TOTAL RAW COST
NO-RETRO	85	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
4LF28/HE/LBF	0	\$26.00	\$35.00	\$0.00	\$0.00	\$0
4LF28/HE/NBF	0	\$26.00	\$35.00	\$0.00	\$0.00	\$0
3LF28/HE/LBF	0	\$24.00	\$35.00	\$0.00	\$0.00	\$0
2LF28/HE/LBF	0	\$22.00	\$35.00	\$0.00	\$0.00	\$0
1LF28/HE/LBF	0	\$20.00	\$35.00	\$0.00	\$0.00	\$0
8'-2LF28/HE/LBF	0	\$22.00	\$35.00	\$0.00	\$0.00	\$0
12'-3LF28/HE/LBF	0	\$28.00	\$40.00	\$0.00	\$0.00	\$0
14'-4LF28/HE/LBF	0	\$30.00	\$50.00	\$0.00	\$0.00	\$0
8'-4LF28/HE/LBF	0	\$30.00	\$35.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
1LF17/HE/LBF	0	\$15.00	\$35.00	\$0.00	\$0.00	\$0
2LF17/HE/LBF	0	\$19.00	\$35.00	\$0.00	\$0.00	\$0
1LF25/HE/LBF	0	\$16.00	\$35.00	\$0.00	\$0.00	\$0
2LF25/HE/LBF	0	\$22.00	\$35.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
2LFB30/HE/LBF	0	\$27.00	\$35.00	\$0.00	\$0.00	\$0
4'-1LF28/HE/NBF/WR/N	0	\$50.00	\$75.00	\$0.00	\$0.00	\$0
8'-2LF28/HE/NBF/WR/N	0	\$70.00	\$75.00	\$0.00	\$0.00	\$0
12'-3LF28/HE/NBF/WR/N	0	\$95.00	\$125.00	\$0.00	\$0.00	\$0
16'-4LF28/HE/NBF/WR/N	0	\$125.00	\$175.00	\$0.00	\$0.00	\$0
4'-2LF28/HE/NBF/WR/N	0	\$60.00	\$75.00	\$0.00	\$0.00	\$0
8'-4LF28/HE/LBF/WR/N	0	\$75.00	\$75.00	\$0.00	\$0.00	\$0
4'-1LF28/HE/NBF/IND/N	0	\$50.00	\$75.00	\$0.00	\$0.00	\$0
8'-2LF28/HE/NBF/IND/N	0	\$75.00	\$75.00	\$0.00	\$0.00	\$0
12'-3LF28/HE/NBF/IND/N	0	\$95.00	\$125.00	\$0.00	\$0.00	\$0
16'-4LF28/HE/NBF/IND/N	0	\$125.00	\$175.00	\$0.00	\$0.00	\$0
4'-2LF28/HE/NBF/IND/N	0	\$60.00	\$75.00	\$0.00	\$0.00	\$0
8'-4LF28/HE/LBF/IND/N	0	\$75.00	\$75.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
4'-1LF28/HE/NBF/ST/N	0	\$45.00	\$75.00	\$0.00	\$0.00	\$0
8'-2LF28/HE/NBF/ST/N	0	\$65.00	\$75.00	\$0.00	\$0.00	\$0
12'-3LF28/HE/NBF/ST/N	0	\$90.00	\$125.00	\$0.00	\$0.00	\$0
16'-4LF28/HE/NBF/WST/N	0	\$120.00	\$175.00	\$0.00	\$0.00	\$0
4'-1LF28/HE/NBF/WWR/N	0	\$70.00	\$75.00	\$0.00	\$0.00	\$0
8'-2LF28/HE/NBF/WWR/N	0	\$90.00	\$75.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
0.000	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0
14W CF/SI	19	\$9.00	\$10.00	\$171.00	\$190.00	\$361
23W CF/SI	0	\$9.00	\$10.00	\$0.00	\$0.00	\$0
1X4-1LF28/HE/NBF/N	0	\$75.00	\$75.00	\$0.00	\$0.00	\$0
2X4-2LF28/HE/NBF/N	0	\$80.00	\$75.00	\$0.00	\$0.00	\$0
2L-13W CF/HW	0	\$25.00	\$40.00	\$0.00	\$0.00	\$0
1L-13W CF/HW	0	\$22.00	\$40.00	\$0.00	\$0.00	\$0
REMOVE & CAP	0	\$10.00	\$50.00	\$0.00	\$0.00	\$0

MATERIAL & LABOR

**Town of Concord  
Hunt Recreation Facility  
ECM: Lighting Improvements**

**MATERIAL AND LABOR BREAKDOWN**

NEW LED EXIT	0	\$20.00	\$60.00	\$0.00	\$0.00	\$0
1L-13W CF/HW/JAR	0	\$45.00	\$40.00	\$0.00	\$0.00	\$0
175W MH/LB	0	\$175.00	\$200.00	\$0.00	\$0.00	\$0
250W MH/LB	0	\$200.00	\$200.00	\$0.00	\$0.00	\$0
250W MH/HB	0	\$200.00	\$200.00	\$0.00	\$0.00	\$0
400W MH/HB	0	\$275.00	\$200.00	\$0.00	\$0.00	\$0
35W HPS WALL PACK	0	\$95.00	\$125.00	\$0.00	\$0.00	\$0
70W HPS WALL PACK	0	\$95.00	\$125.00	\$0.00	\$0.00	\$0
35W HPS CANOPY	0	\$110.00	\$125.00	\$0.00	\$0.00	\$0
70W HPS CANOPY	0	\$110.00	\$125.00	\$0.00	\$0.00	\$0
35W HPS MINI-FLOOD	0	\$95.00	\$125.00	\$0.00	\$0.00	\$0
70W HPS MINI-FLOOD	0	\$95.00	\$125.00	\$0.00	\$0.00	\$0
150W HPS/FLOOD	0	\$195.00	\$175.00	\$0.00	\$0.00	\$0
250W HPS/FLOOD	0	\$195.00	\$175.00	\$0.00	\$0.00	\$0
400W HPS/FLOOD	0	\$195.00	\$175.00	\$0.00	\$0.00	\$0
100W HPS/LB	0	\$175.00	\$200.00	\$0.00	\$0.00	\$0
150W HPS/LB	0	\$195.00	\$200.00	\$0.00	\$0.00	\$0
4L-T5/HO/N	16	\$225.00	\$250.00	\$3,600.00	\$4,000.00	\$7,600
3L-T5/HO/N	0	\$200.00	\$250.00	\$0.00	\$0.00	\$0
2L-T5/HO/N	0	\$160.00	\$250.00	\$0.00	\$0.00	\$0
4L-T8/HP/N	0	\$130.00	\$150.00	\$0.00	\$0.00	\$0
3L-T8/HP/N	0	\$125.00	\$150.00	\$0.00	\$0.00	\$0
2L-T8/HP/N	0	\$90.00	\$150.00	\$0.00	\$0.00	\$0
1LF59/LBF	0	\$30.00	\$30.00	\$0.00	\$0.00	\$0
2LF59/LBF	0	\$35.00	\$30.00	\$0.00	\$0.00	\$0
2L-T8/HP/N	0	\$90.00	\$150.00	\$0.00	\$0.00	\$0
1LF59/LBF	0	\$30.00	\$30.00	\$0.00	\$0.00	\$0
2LF59/LBF	0	\$35.00	\$30.00	\$0.00	\$0.00	\$0

**TOTALS :** **120** **\$3,771.00** **\$4,190.00** **\$7,961.00**

<b>HAZARDOUS WASTE</b>	<b>\$59.60</b>
<b>LIGHTING RAW COST</b>	<b>\$8,020.60</b>
<b>TOTAL</b>	<b>\$8,020.60</b>

SIMPLE PAYBACK
6.46

<b>OCCUPANCY SENSORS</b>	<b>QUANTITY</b>	<b>MATERIAL COST</b>	<b>LABOR COST</b>	<b>TOTAL MATERIAL</b>	<b>TOTAL LABOR</b>	<b>TOTAL RAW COST</b>
SWITCH MOUNT	20	\$ 50.00	\$ 35.00	\$1,000.00	\$700.00	\$1,700.00
CEILING MOUNT	1	\$ 110.00	\$ 150.00	\$110.00	\$150.00	\$260.00

**TOTALS :** **21** **\$1,110.00** **\$850.00** **\$1,960.00**

C:\Documents and Settings\Owner\Desktop\Concord New\Concord Lighting Revised\[Hunt lighting 2.xls]EXISTING MAT.



EXIST CODE	FIXTURE TYPE	WATTS	# OF LAMPS	# OF BALS.	REPL. CODE	PROPOSED FIXTURE	WATTS	MAT. COST	LABOR COST	# OF BALS.	# OF LAMPS
1	2X4-4LF40/EE/EEM	140	4	2	100	NO-RETRO	0	0	0	0	0
2	2X4-3LF40/EE/EEM	110	3	2	101						
3	2X4-2LF40/EE/EEM	70	2	1	102	4LF28/HE/LBF	82	26	35	1	2
4	1X4-2LF40/EE/EEM	70	2	1	103	4LF28/HE/NBF	93	26	35	1	4
5					104	3LF28/HE/LBF	63	24	35	1	3
6	2X2-2LFB40/ES/EEM	70	2	1	105	2LF28/HE/LBF	42	22	35	1	2
7	2X2-4LF20/ES/STD	112	4	2	106	1LF28/HE/LBF	23	20	35	1	1
8					107	8'-2LF28/HE/LBF	42	22	35	1	2
9	4'-WRAP-1LF40/EE/EEM	40	1	1	108	12'-3LF28/HE/LBF	63	28	40	1	3
10	4'-WRAP-2LF40/EE/EEM	70	2	1	109	14'-4LF28/HE/LBF	82	30	50	1	4
11	4'-WRAP-3LF40/EE/EEM	110	3	2	110	8'-4LF28/HE/LBF	82	30	35	1	4
12	4'-WRAP-4LF40/EE/EEM	140	4	2	111						
13	2'-WALL WR-2LF20/EEM/STD	56	2	1	112						
14	4'-WALL WR-1LF40/EE/EEM	40	1	1	113						
15	4'-WALL WR-2LF40/EE/EEM	70	2	1	114						
16	4'-DAMP WR-1LF40/EE/EEM	40	1	1	115	1LF17/HE/LBF	15	15	35	1	1
17	8'-DAMP WR-1LF96/EE/EEM	83	1	1	116	2LF17/HE/LBF	27	19	35	1	2
18	8'-DAMP WR-2LF96/EE/EEM	123	2	1	117	1LF25/HE/LBF	20	16	35	1	1
19	8'-WRAP-4LF40/EE/EEM	140	4	2	118	2LF25/HE/LBF	39	22	35	1	2
20	4'-IND-1LF40/EE/EEM	40	1	1	119						
21	4'-IND-2LF40/EE/EEM	70	2	1	120						
22	4'-IND-3LF40/EE/EEM	110	3	2	121						
23	4'-IND-4LF40/EE/EEM	140	4	2	122	2LFB30/HE/LBF	45	27	35	1	2
24	4'-IND-2LF40/HO/STD	145	2	1	123	4'-1LF28/HE/NBF/WR/N	25	50	75	1	1
25	8'-IND-4LF40/EE/EEM	140	4	2	124	8'-2LF28/HE/NBF/WR/N	47	70	75	1	2
26	8'-IND-2LF96/EE/EEM	123	2	1	125	12'-3LF28/HE/NBF/WR/N	72	95	125	1	3
27	8'-IND-3LF96/EE/EEM	206	3	2	126	16'-4LF28/HE/NBF/WR/N	94	125	175	1	4
28	8'-IND-2LF96/HO/STD	227	2	1	127	4'-2LF28/HE/NBF/WR/N	47	60	75	1	2
29	8'-IND-4LF96/HO/STD	454	4	2	128	8'-4LF28/HE/LBF/WR/N	82	75	75	1	4
30	2'-STR-1LF20/EEM/STD	32	1	1	129	4'-1LF28/HE/NBF/IND/N	25	50	75	1	1
31	3'-STR-1LF30/EEM/STD	46	1	1	130	8'-2LF28/HE/NBF/IND/N	47	75	75	1	2
32	3'-STR-2LF30/EEM/STD	80	2	1	131	12'-3LF28/HE/NBF/IND/N	72	95	125	1	3
33	4'-STR-1LF40/EE/EEM	40	1	1	132	16'-4LF28/HE/NBF/IND/N	94	125	175	1	4
34	4'-STR-2LF40/EE/EEM	70	2	1	133	4'-2LF28/HE/NBF/IND/N	47	60	75	1	2
35	8'-STR-2LF40/EE/EEM	70	2	1	134	8'-4LF28/HE/LBF/IND/N	82	75	75	1	4
36	8'-STR-1LF96/EE/EEM	83	1	1	135						
37	8'-STR-2LF96/EE/EEM	123	2	1	136	4'-1LF28/HE/NBF/ST/N	25	45	75	1	1
38	4'-ICE TRAY-2LF40/EE/EEM	70	2	1	137	8'-2LF28/HE/NBF/ST/N	47	65	75	1	2
39	8'-ICE TRAY-4LF40/EE/EEM	140	4	2	138	12'-3LF28/HE/NBF/ST/N	72	90	125	1	3
40	4'-ICE TRAY-4LF40/EE/EEM	140	4	2	139	16'-4LF28/HE/NBF/WST/N	94	120	175	1	4
41	8'-ICE TRAY-2LF96/EE/EEM	123	2	1	140	4'-1LF28/HE/NBF/WWR/N	25	70	75	1	1
42	8'-ICE TRAY-4LF96/EE/EEM	246	4	2	141	8'-2LF28/HE/NBF/WWR/N	47	90	75	1	2
43	4'-BOX-2LF40/EE/EEM	70	2	1	142						
44	4'-BOX-3LF40/EE/EEM	110	4	2	143						
45					144	14W CF/SI	14	9	10	0	1
46					145	23W CF/SI	23	9	10	0	1
47	INCAND-1L/60W	60	1	0	146	1X4-1LF28/HE/NBF/N	25	75	75	1	1
48	INCAND-1L/90W	90	1	0	147	2X4-2LF28/HE/NBF/N	47	80	75	1	2
49	INCAND-1L/150W	150	1	0	148	2L-13W CF/HW	30	25	40	2	2
50	INCAND-1L/200W	200	1	0	149	1L-13W CF/HW	15	22	40	1	1
51	INCAND-1L/300W	300	1	0	150	REMOVE & CAP	0	10	50	0	0
52	INCAND JAR-1L/75W	75	1	0	151	NEW LED EXIT	3	20	60	0	0
53	INCAND DRUM-1L/60W	60	1	0	152	1L-13W CF/HW/JAR	15	45	40	0	1
54	INCAND DRUM-2L/60W	120	2	0	153	175W MH/LB	205	175	200	1	1
55	INCAND DRUM-3L/60W	180	3	0	154	250W MH/LB	295	200	200	1	1
56	INCAND EXIT-2L/15W	30	2	0	155	250W MH/HB	295	200	200	1	1
57	FLUOR EXIT-2L/7W	18	2	0	156	400W MH/HB	455	275	200	1	1
58	QUARTZ-IL/300W	300	1	0	157	35W HPS WALL PACK	50	95	125	1	1

## **Appendix B – ECM #2**

**Town Of Concord**

**Concord Town House**

**ECM #2 - EMS Installation - Annual Energy Savings Estimate**

Percent Saved With Storm Windows: 11%									
					Estimated % Energy Savings		Annual Energy Units Saved		
Space Heating									
				Existing					
Estimated Annual Btu/SF/Year				40,299					
Building Heated Square Feet				14,838					
Heat Generation Efficiency				83%	New EMS		New EMS		Total
Estimated Annual Input MMBtu				720	15.0%		108		108
Space Cooling							Therms: 1,081		
				Existing					
Total Installed Tons				45					
Estimated Full Load Tons				41					
Estimated Annual Full-Load Hours				718					
Cooling Design kW Per Ton				1.30					
Cooling Average kW Per Ton				1.11			New EMS		Total
Auxiliaries Average kW Per Ton				0.08					
Cooling - Total Annual kWh				72,320	25.0%		18,080		18,080
HVAC Fans									
				Existing					
Estimated Total Motor HP				6					
Estimated Total BHP				5					
Motors - Average Efficiency				70%					
Estimated Average Running Load Factor				1.00					
Total Fan Load - Average Input kW				5.1					
Estimated Annual Run- Hours				2,868	New EMS		New EMS		Total
Fans - Total Annual kWh				14,670	25.0%		3,668		3,668
Breakdown Of Btu Consumption Per Square Foot Existing And Proposed									
	Space Heating	Space Cooling	HVAC Fans	Total					
Existing	40,299	16,635	3,374	60,308					
Proposed	34,254	12,476	2,531	49,261					
Overall Percent Savings				18%					



**Town Of Concord**  
**133 Keyes Road (Garage Section)**  
**ECM #2 - EMS Installation- Improved Temperature Control - Annual Energy Savings Estimate**

**I. Heating System Capacity Data And Operating Parameters**

Existing Space Heating Systems - Estimated Design Capacity Data							Daily/Weekly Occupancy Schedule						
Building Heated Floor Area - Square Feet		14,588				Scheduling Control In Place (Y/N)		Y	(Manual Only)				
Estimated Peak Heating Load Factor - Btu/Hr/SF		30.0											
Indoor Design Temperature		70 °F				Existing System Heating System "Occupied" Schedule		Percent Occupied Times By Daily Time Period					
Outdoor Design Temperature		5 °F						12 AM To 8 AM	8 AM To 4 PM	4 PM To 12 AM			
Estimated Building U*A Factor - Btu/Hour/Deg. F		6,733				Manual Control Only							
Heating System Operating Setpoints - Existing And Proposed								Start	End				
				Existing	Proposed		Monday	6:00 AM	6:00 PM	25%	100%	25%	
							Tuesday	6:00 AM	6:00 PM	25%	100%	25%	
Space Heating Outside Air "Lockout" Temperature				65 °F	55 °F		Wednesday	6:00 AM	6:00 PM	25%	100%	25%	
							Thursday	6:00 AM	6:00 PM	25%	100%	25%	
Estimated Space Temperatures Maintained - Existing System							Friday	6:00 AM	6:00 PM	25%	100%	25%	
Outside Air Temperature Range		Occupied Hours			Unocc. Hours	Saturday		7:00 AM	7:00 AM	0%	0%	0%	
		12 AM To 8 AM				Sunday		7:00 AM	7:00 AM	0%	0%	0%	
		8 AM To 4 PM						Annual Total			18%	71%	18%
		4 PM To 12 AM						Annual Occupied Hours Per Period			521	2,083	521
		65 °F To 66 °F						Total Annual Occupied Hours			3,125	36%	
0 °F To 30 °F		65 °F	65 °F	65 °F	60 °F								
30 °F To 40 °F		66 °F	66 °F	66 °F	60 °F								
40 °F To 70 °F		66 °F	66 °F	66 °F	60 °F								
							Proposed System Heating System "Occupied" Schedule		Percent Occupied Times By Daily Time Period				
				Occupied	Unocc.				12 AM To 8 AM	8 AM To 4 PM	4 PM To 12 AM		
Proposed Average Space Temperature With EMS				62 °F	55 °F								
								Start	End				
Annual Months Of Heating System Operation							Monday	7:00 AM	5:00 PM	13%	100%	13%	
							Tuesday	7:00 AM	5:00 PM	13%	100%	13%	
		Space Heating Enabled		Space Heating Enabled		Wednesday	7:00 AM	5:00 PM	13%	100%	13%		
						Thursday	7:00 AM	5:00 PM	13%	100%	13%		
Month			Month			Friday	7:00 AM	5:00 PM	13%	100%	13%		
January	100%		July	0%		Saturday	7:00 AM	7:00 AM	0%	0%	0%		
February	100%		August	0%		Sunday	7:00 AM	7:00 AM	0%	0%	0%		
March	100%		September	25%		Annual Total			9%	71%	9%		
April	50%		October	50%		Annual Occupied Hours Per Period			261	2,083	261		
May	0%		November	100%		Total Annual Occupied Hours			2,604	30%			
June	0%		December	100%									

**Town Of Concord                                      133 Keyes Road (Garage Section)**  
**ECM #2 - EMS Installation- Improved Temperature Control - Annual Energy Savings Estimate**

**II. Existing Control System - Estimated Annual Heating Energy Usage - Occupied Hours**

<b>Building:</b> 133 Keyes Road (Garage Section)
<b>Weather Data Location:</b> Bedford, Massachusetts

Outside Air Temp. Bin Deg. F	Daily Time Period	Heating Energy Usage 12 AM To 8 AM			Daily Time Period	Heating Energy Usage 8 AM To 4 PM			Daily Time Period	Heating Energy Usage 4 PM To 12 AM		
	12 AM To 8 AM	Existing Average Space Temp.	Existing Average MBH	Space Heating Annual MMBtu	8 AM To 4 PM	Existing Average Space Temp.	Existing Average MBH	Space Heating Annual MMBtu	4 PM To 12 AM	Existing Average Space Temp.	Existing Average MBH	Space Heating Annual MMBtu
	Heating Hours				Heating Hours				Heating Hours			
95 / 99	0	66 °F	0	0	0	66 °F	0	0	0	66 °F	0	0
90 / 94	0	66 °F	0	0	0	66 °F	0	0	0	66 °F	0	0
85 / 89	0	66 °F	0	0	2	66 °F	0	0	0	66 °F	0	0
80 / 84	0	66 °F	0	0	5	66 °F	0	0	0	66 °F	0	0
75 / 79	0	66 °F	0	0	13	66 °F	0	0	1	66 °F	0	0
70 / 74	1	66 °F	0	0	19	66 °F	0	0	2	66 °F	0	0
65 / 69	2	66 °F	0	0	29	66 °F	0	0	4	66 °F	0	0
60 / 64	4	66 °F	27	0	46	66 °F	27	1	7	66 °F	27	0
55 / 59	8	66 °F	61	0	65	66 °F	61	4	11	66 °F	61	1
50 / 54	12	66 °F	94	1	84	66 °F	94	8	15	66 °F	94	1
45 / 49	16	66 °F	128	2	100	66 °F	128	13	20	66 °F	128	3
40 / 44	23	66 °F	162	4	146	66 °F	162	24	30	66 °F	162	5
35 / 39	36	66 °F	195	7	160	66 °F	195	31	43	66 °F	195	8
30 / 34	48	66 °F	229	11	151	66 °F	229	35	47	66 °F	229	11
25 / 29	37	65 °F	256	9	106	65 °F	256	27	33	65 °F	256	8
20 / 24	28	65 °F	290	8	67	65 °F	290	19	23	65 °F	290	7
15 / 19	19	65 °F	323	6	45	65 °F	323	15	15	65 °F	323	5
10 / 14	15	65 °F	357	5	23	65 °F	357	8	10	65 °F	357	3
5 / 9	11	65 °F	391	4	11	65 °F	391	4	6	65 °F	391	2
0 / 4	6	65 °F	424	3	4	65 °F	424	2	2	65 °F	424	1
-5 / -1	2	65 °F	458	1	1	65 °F	458	1	1	65 °F	458	0
-10 / -6	1	65 °F	492	1	0	65 °F	492	0	0	65 °F	492	0
-15 / -11	1	65 °F	525	0	0	65 °F	525	0	0	65 °F	525	0
-20 / -16	0	65 °F	559	0	0	65 °F	559	0	0	65 °F	559	0
<b>Totals</b>	<b>270</b>			<b>64</b>	<b>1,079</b>			<b>191</b>	<b>270</b>			<b>56</b>



**Town Of Concord                                      133 Keyes Road (Garage Section)**  
**ECM #2 - EMS Installation- Improved Temperature Control - Annual Energy Savings Estimate**

**III. Existing Control System - Estimated Annual Heating Energy Usage - Unoccupied Hours**

<b>Building:</b> 133 Keyes Road (Garage Section)
<b>Weather Data Location:</b> Bedford, Massachusetts

Outside Air Temp. Bin Deg. F	Daily Time Period	Heating Energy Usage 12 AM To 8 AM			Daily Time Period	Heating Energy Usage 8 AM To 4 PM			Daily Time Period	Heating Energy Usage 4 PM To 12 AM		
	12 AM To 8 AM	Existing Average Space Temp.	Existing Average MBH	Space Heating Annual MMBtu	8 AM To 4 PM	Existing Average Space Temp.	Existing Average MBH	Space Heating Annual MMBtu	4 PM To 12 AM	Existing Average Space Temp.	Existing Average MBH	Space Heating Annual MMBtu
	Heating Hours				Heating Hours				Heating Hours			
95 / 99	0	60 °F	0	0	0	60 °F	0	0	0	60 °F	0	0
90 / 94	0	60 °F	0	0	0	60 °F	0	0	0	60 °F	0	0
85 / 89	0	60 °F	0	0	1	60 °F	0	0	0	60 °F	0	0
80 / 84	0	60 °F	0	0	2	60 °F	0	0	1	60 °F	0	0
75 / 79	0	60 °F	0	0	5	60 °F	0	0	3	60 °F	0	0
70 / 74	4	60 °F	0	0	8	60 °F	0	0	9	60 °F	0	0
65 / 69	7	60 °F	0	0	12	60 °F	0	0	19	60 °F	0	0
60 / 64	21	60 °F	0	0	19	60 °F	0	0	33	60 °F	0	0
55 / 59	35	60 °F	20	1	26	60 °F	20	1	52	60 °F	20	1
50 / 54	55	60 °F	54	3	33	60 °F	54	2	70	60 °F	54	4
45 / 49	73	60 °F	88	6	40	60 °F	88	3	94	60 °F	88	8
40 / 44	105	60 °F	121	13	59	60 °F	121	7	139	60 °F	121	17
35 / 39	165	60 °F	155	26	64	60 °F	155	10	197	60 °F	155	31
30 / 34	220	60 °F	189	42	60	60 °F	189	11	216	60 °F	189	41
25 / 29	168	60 °F	222	37	42	60 °F	222	9	150	60 °F	222	33
20 / 24	130	60 °F	256	33	27	60 °F	256	7	106	60 °F	256	27
15 / 19	88	60 °F	290	26	18	60 °F	290	5	71	60 °F	290	20
10 / 14	68	60 °F	323	22	9	60 °F	323	3	44	60 °F	323	14
5 / 9	53	60 °F	357	19	5	60 °F	357	2	25	60 °F	357	9
0 / 4	30	60 °F	391	12	2	60 °F	391	1	7	60 °F	391	3
-5 / -1	11	60 °F	424	5	1	60 °F	424	0	3	60 °F	424	1
-10 / -6	6	60 °F	458	3	0	60 °F	458	0	1	60 °F	458	0
-15 / -11	2	60 °F	492	1	0	60 °F	492	0	0	60 °F	492	0
-20 / -16	1	60 °F	525	0	0	60 °F	525	0	0	60 °F	525	0
<b>Totals</b>	<b>1,241</b>			<b>247</b>	<b>432</b>			<b>61</b>	<b>1,242</b>			<b>210</b>

**Town Of Concord                                      133 Keyes Road (Garage Section)**  
**ECM #2 - EMS Installation- Improved Temperature Control - Annual Energy Savings Estimate**

**IV. Proposed Control System - Estimated Annual Heating Energy Usage - Occupied Hours**

<b>Building:</b> 133 Keyes Road (Garage Section)
<b>Weather Data Location:</b> Bedford, Massachusetts

Outside Air Temp. Bin Deg. F	Daily Time Period	Heating Energy Usage 12 AM To 8 AM			Daily Time Period	Heating Energy Usage 8 AM To 4 PM			Daily Time Period	Heating Energy Usage 4 PM To 12 AM		
	12 AM To 8 AM	Proposed Average Space Temp.	Proposed Average MBH	Space Heating Annual MMBtu	8 AM To 4 PM	Proposed Average Space Temp.	Proposed Average MBH	Space Heating Annual MMBtu	4 PM To 12 AM	Proposed Average Space Temp.	Proposed Average MBH	Space Heating Annual MMBtu
	Heating Hours				Heating Hours				Heating Hours			
95 / 99	0	62 °F	0	0	0	62 °F	0	0	0	62 °F	0	0
90 / 94	0	62 °F	0	0	0	62 °F	0	0	0	62 °F	0	0
85 / 89	0	62 °F	0	0	2	62 °F	0	0	0	62 °F	0	0
80 / 84	0	62 °F	0	0	5	62 °F	0	0	0	62 °F	0	0
75 / 79	0	62 °F	0	0	13	62 °F	0	0	0	62 °F	0	0
70 / 74	0	62 °F	0	0	19	62 °F	0	0	1	62 °F	0	0
65 / 69	1	62 °F	0	0	29	62 °F	0	0	2	62 °F	0	0
60 / 64	2	62 °F	0	0	46	62 °F	0	0	4	62 °F	0	0
55 / 59	4	62 °F	0	0	65	62 °F	0	0	6	62 °F	0	0
50 / 54	6	62 °F	67	0	84	62 °F	67	6	8	62 °F	67	1
45 / 49	8	62 °F	101	1	100	62 °F	101	10	10	62 °F	101	1
40 / 44	11	62 °F	135	2	146	62 °F	135	20	15	62 °F	135	2
35 / 39	18	62 °F	168	3	160	62 °F	168	27	21	62 °F	168	4
30 / 34	24	62 °F	202	5	151	62 °F	202	31	23	62 °F	202	5
25 / 29	18	62 °F	236	4	106	62 °F	236	25	16	62 °F	236	4
20 / 24	14	62 °F	269	4	67	62 °F	269	18	12	62 °F	269	3
15 / 19	10	62 °F	303	3	45	62 °F	303	14	8	62 °F	303	2
10 / 14	7	62 °F	337	2	23	62 °F	337	8	5	62 °F	337	2
5 / 9	6	62 °F	370	2	11	62 °F	370	4	3	62 °F	370	1
0 / 4	3	62 °F	404	1	4	62 °F	404	2	1	62 °F	404	0
-5 / -1	1	62 °F	438	1	1	62 °F	438	1	0	62 °F	438	0
-10 / -6	1	62 °F	471	0	0	62 °F	471	0	0	62 °F	471	0
-15 / -11	0	62 °F	505	0	0	62 °F	505	0	0	62 °F	505	0
-20 / -16	0	62 °F	539	0	0	62 °F	539	0	0	62 °F	539	0
<b>Totals</b>	<b>135</b>			<b>29</b>	<b>1,079</b>			<b>164</b>	<b>135</b>			<b>24</b>

**Town Of Concord**  
**133 Keyes Road (Garage Section)**  
**ECM #2 - EMS Installation- Improved Temperature Control - Annual Energy Savings Estimate**

**V. Proposed Control System - Estimated Annual Heating Energy Usage - Unoccupied Hours**

<b>Building:</b> 133 Keyes Road (Garage Section)
<b>Weather Data Location:</b> Bedford, Massachusetts

Outside Air Temp. Bin Deg. F	Daily Time Period	Heating Energy Usage 12 AM To 8 AM			Daily Time Period	Heating Energy Usage 8 AM To 4 PM			Daily Time Period	Heating Energy Usage 4 PM To 12 AM		
	12 AM To 8 AM	Proposed Average Space Temp.	Proposed Average MBH	Space Heating Annual MMBtu	8 AM To 4 PM	Proposed Average Space Temp.	Proposed Average MBH	Space Heating Annual MMBtu	4 PM To 12 AM	Proposed Average Space Temp.	Proposed Average MBH	Space Heating Annual MMBtu
	Heating Hours				Heating Hours				Heating Hours			
95 / 99	0	55 °F	0	0	0	55 °F	0	0	0	55 °F	0	0
90 / 94	0	55 °F	0	0	0	55 °F	0	0	0	55 °F	0	0
85 / 89	0	55 °F	0	0	1	55 °F	0	0	0	55 °F	0	0
80 / 84	0	55 °F	0	0	2	55 °F	0	0	1	55 °F	0	0
75 / 79	0	55 °F	0	0	5	55 °F	0	0	4	55 °F	0	0
70 / 74	4	55 °F	0	0	8	55 °F	0	0	10	55 °F	0	0
65 / 69	8	55 °F	0	0	12	55 °F	0	0	21	55 °F	0	0
60 / 64	23	55 °F	0	0	19	55 °F	0	0	37	55 °F	0	0
55 / 59	38	55 °F	0	0	26	55 °F	0	0	57	55 °F	0	0
50 / 54	61	55 °F	20	1	33	55 °F	20	1	78	55 °F	20	2
45 / 49	81	55 °F	54	4	40	55 °F	54	2	104	55 °F	54	6
40 / 44	116	55 °F	88	10	59	55 °F	88	5	154	55 °F	88	13
35 / 39	183	55 °F	121	22	64	55 °F	121	8	219	55 °F	121	26
30 / 34	244	55 °F	155	38	60	55 °F	155	9	240	55 °F	155	37
25 / 29	186	55 °F	189	35	42	55 °F	189	8	167	55 °F	189	31
20 / 24	144	55 °F	222	32	27	55 °F	222	6	117	55 °F	222	26
15 / 19	98	55 °F	256	25	18	55 °F	256	5	78	55 °F	256	20
10 / 14	76	55 °F	290	22	9	55 °F	290	3	49	55 °F	290	14
5 / 9	58	55 °F	323	19	5	55 °F	323	1	28	55 °F	323	9
0 / 4	33	55 °F	357	12	2	55 °F	357	1	8	55 °F	357	3
-5 / -1	12	55 °F	391	5	1	55 °F	391	0	4	55 °F	391	1
-10 / -6	6	55 °F	424	3	0	55 °F	424	0	1	55 °F	424	0
-15 / -11	3	55 °F	458	1	0	55 °F	458	0	0	55 °F	458	0
-20 / -16	1	55 °F	492	0	0	55 °F	492	0	0	55 °F	492	0
<b>Totals</b>	<b>1,376</b>			<b>229</b>	<b>432</b>			<b>49</b>	<b>1,377</b>			<b>190</b>

**Town Of Concord    133 Keyes Road (Garage Section And Office Section)**  
**ECM #2 - EMS Installation- Improved Temperature Control - Annual Energy Savings Estimate**

## **VI. Proposed Control System - Estimated Annual Fuel Energy Savings**

Annual Heating Energy Savings (Therms)						
<u><b>Garage Section</b></u>						
		Annual Space Heating Energy Use			Percent	
		Existing	Proposed	Saved	Saved	
	Total Space Heating End-Use MMBtu	829	685	145	17%	
	Space Heating End-Use Btu/SF/Year	56,852	46,932	9,920		
Annual Space Heating Natural Gas Usage						
	Space Heating System Efficiency:	82%			Percent	
		Existing	Proposed	Saved	Saved	
	Total Space Heating Input Therms	10,114	8,349	1,765	17%	
	Space Input Btu/SF/Year	69,331	57,234	12,098		
<u><b>Office Section And Building Totals</b></u>						
	Office Section - Square Footage	3,680				
	Estimated Seasonal Boiler Efficiency	75%				
	Estimated Existing Btu/Sf/Year	50,000				
	Estimated Existing Therms	2,453				
	Estimated Proposed Btu/Sf/Year	40,000				
	Estimated Proposed Therms	1,963				
	Estimated Therms Saved - Improved Control With EMS	491				
	Estimated Therms Saved - Demand-Controlled Ventilation	241				
	Garage Section Annual Therms Saved	1,765				
	Total Building Annual Therms Saved	<u>2,497</u>				

**Town Of Concord                                      133 Keyes Road (Garage Section And Office Section)**  
**ECM #2 - EMS Installation- Improved Temperature Control - Annual Energy Savings Estimate**

**VII. Proposed Control System - Estimated Annual Electrical Energy Savings**

Annual Electrical Energy Savings (kWh)						
<u>Garage Section</u>		Total HP	Total kW	Existing Run Hours	Proposed Run Hours	
	Exhaust Fans	1.67	1.49	1,200	700	
	MUA Unit Supply Fans	4	3.44	700	500	
	Unit Heater Fans	3	2.69	1,080	840	
		All Fans - Total Annual kWh Saved			2,081	
<u>Office Section And Building Totals</u>						
		Tons	kW/Ton	Total kW		
	Air Conditioning Load Factors	12.75	1.3	16.1		
		Existing	Proposed			
	Annual Scheduled Hours	1,697	1,256			
	Average Percent Load	60%	50%	Annual kWh Saved		
	Equivalent Full Load Hours	1,018	628			
	Average kW Per Ton	1.0	1.0			
	Annual Air Conditioning kWh	1,029	635		394	
	Estimated kWh Saved - Office Air Conditioning Control				394	
	Estimated kWh Saved - Demand-Controlled Ventilation				435	
	Garage Section Annual kWh Saved				2,081	
	Total Building Annual kWh Saved				<u>2,910</u>	

**Town Of Concord**                      **135 Keyes Road (Garage Section)**  
**ECM #2 - EMS Installation- Improved Temperature Control - Annual Energy Savings Estimate**

**I. Heating System Capacity Data And Operating Parameters**

Existing Space Heating Systems - Estimated Design Capacity Data							Daily/Weekly Occupancy Schedule					
Building Heated Floor Area - Square Feet		4,850				Scheduling Control In Place (Y/N)		Y	(Manual Only)			
Estimated Peak Heating Load Factor - Btu/Hr/SF		30.0										
Indoor Design Temperature		70 °F				Existing System Heating System "Occupied" Schedule		Percent Occupied Times By Daily Time Period				
Outdoor Design Temperature		5 °F						12 AM To 8 AM	8 AM To 4 PM	4 PM To 12 AM		
Estimated Building U*A Factor - Btu/Hour/Deg. F		2,238				Manual Control Only						
<u>Heating System Operating Setpoints - Existing And Proposed</u>								Start	End			
				Existing	Proposed		Monday	6:00 AM	6:00 PM	25%	100%	25%
							Tuesday	6:00 AM	6:00 PM	25%	100%	25%
Space Heating Outside Air "Lockout" Temperature				65 °F	55 °F		Wednesday	6:00 AM	6:00 PM	25%	100%	25%
							Thursday	6:00 AM	6:00 PM	25%	100%	25%
Estimated Space Temperatures Maintained - Existing System							Friday	6:00 AM	6:00 PM	25%	100%	25%
Outside Air Temperature Range		Occupied Hours			Unocc. Hours	Saturday		7:00 AM	7:00 AM	0%	0%	0%
		12 AM To 8 AM	8 AM To 4 PM	4 PM To 12 AM		Sunday		7:00 AM	7:00 AM	0%	0%	0%
						Annual Total		18%	71%	18%		
						Annual Occupied Hours Per Period		521	2,083	521		
						Total Annual Occupied Hours		3,125	36%			
0 °F To 30 °F		65 °F	65 °F	65 °F	62 °F							
30 °F To 40 °F		66 °F	66 °F	66 °F	62 °F							
40 °F To 70 °F		66 °F	66 °F	66 °F	62 °F							
							Proposed System Heating System "Occupied" Schedule		Percent Occupied Times By Daily Time Period			
				Occupied	Unocc.				12 AM To 8 AM	8 AM To 4 PM	4 PM To 12 AM	
Proposed Average Space Temperature With EMS				62 °F	55 °F							
<u>Annual Months Of Heating System Operation</u>								Start	End			
							Monday	7:00 AM	5:00 PM	13%	100%	13%
							Tuesday	7:00 AM	5:00 PM	13%	100%	13%
	Month	Space Heating Enabled	Month	Space Heating Enabled			Wednesday	7:00 AM	5:00 PM	13%	100%	13%
					Thursday	7:00 AM	5:00 PM	13%	100%	13%		
					Friday	7:00 AM	5:00 PM	13%	100%	13%		
					Saturday	7:00 AM	7:00 AM	0%	0%	0%		
					Sunday	7:00 AM	7:00 AM	0%	0%	0%		
January		100%	July	0%			Annual Total		9%	71%	9%	
February		100%	August	0%			Annual Occupied Hours Per Period		261	2,083	261	
March		100%	September	25%			Total Annual Occupied Hours		2,604	30%		
April		50%	October	50%								
May		0%	November	100%								
June		0%	December	100%								



**Town Of Concord                                      135 Keyes Road (Garage Section)**

**ECM #2 - EMS Installation- Improved Temperature Control - Annual Energy Savings Estimate**

## II. Existing Control System - Estimated Annual Heating Energy Usage - Occupied Hours

<b>Building:</b> 135 Keyes Road (Garage Section)
<b>Weather Data Location:</b> Bedford, Massachusetts

Outside Air Temp. Bin Deg. F	Daily Time Period	Heating Energy Usage 12 AM To 8 AM			Daily Time Period	Heating Energy Usage 8 AM To 4 PM			Daily Time Period	Heating Energy Usage 4 PM To 12 AM		
	12 AM To 8 AM	Existing Average Space Temp.	Existing Average MBH	Space Heating Annual MMBtu	8 AM To 4 PM	Existing Average Space Temp.	Existing Average MBH	Space Heating Annual MMBtu	4 PM To 12 AM	Existing Average Space Temp.	Existing Average MBH	Space Heating Annual MMBtu
	Heating Hours				Heating Hours				Heating Hours			
95 / 99	0	66 °F	0	0	0	66 °F	0	0	0	66 °F	0	0
90 / 94	0	66 °F	0	0	0	66 °F	0	0	0	66 °F	0	0
85 / 89	0	66 °F	0	0	2	66 °F	0	0	0	66 °F	0	0
80 / 84	0	66 °F	0	0	5	66 °F	0	0	0	66 °F	0	0
75 / 79	0	66 °F	0	0	13	66 °F	0	0	1	66 °F	0	0
70 / 74	1	66 °F	0	0	19	66 °F	0	0	2	66 °F	0	0
65 / 69	2	66 °F	0	0	29	66 °F	0	0	4	66 °F	0	0
60 / 64	4	66 °F	9	0	46	66 °F	9	0	7	66 °F	9	0
55 / 59	8	66 °F	20	0	65	66 °F	20	1	11	66 °F	20	0
50 / 54	12	66 °F	31	0	84	66 °F	31	3	15	66 °F	31	0
45 / 49	16	66 °F	43	1	100	66 °F	43	4	20	66 °F	43	1
40 / 44	23	66 °F	54	1	146	66 °F	54	8	30	66 °F	54	2
35 / 39	36	66 °F	65	2	160	66 °F	65	10	43	66 °F	65	3
30 / 34	48	66 °F	76	4	151	66 °F	76	11	47	66 °F	76	4
25 / 29	37	65 °F	85	3	106	65 °F	85	9	33	65 °F	85	3
20 / 24	28	65 °F	96	3	67	65 °F	96	6	23	65 °F	96	2
15 / 19	19	65 °F	107	2	45	65 °F	107	5	15	65 °F	107	2
10 / 14	15	65 °F	119	2	23	65 °F	119	3	10	65 °F	119	1
5 / 9	11	65 °F	130	1	11	65 °F	130	1	6	65 °F	130	1
0 / 4	6	65 °F	141	1	4	65 °F	141	1	2	65 °F	141	0
-5 / -1	2	65 °F	152	0	1	65 °F	152	0	1	65 °F	152	0
-10 / -6	1	65 °F	163	0	0	65 °F	163	0	0	65 °F	163	0
-15 / -11	1	65 °F	175	0	0	65 °F	175	0	0	65 °F	175	0
-20 / -16	0	65 °F	186	0	0	65 °F	186	0	0	65 °F	186	0
Totals	270			21	1,079			64	270			18

**Town Of Concord                                      135 Keyes Road (Garage Section)**  
**ECM #2 - EMS Installation- Improved Temperature Control - Annual Energy Savings Estimate**

**III. Existing Control System - Estimated Annual Heating Energy Usage - Unoccupied Hours**

<b>Building:</b> 135 Keyes Road (Garage Section)
<b>Weather Data Location:</b> Bedford, Massachusetts

Outside Air Temp. Bin Deg. F	Daily Time Period	Heating Energy Usage 12 AM To 8 AM			Daily Time Period	Heating Energy Usage 8 AM To 4 PM			Daily Time Period	Heating Energy Usage 4 PM To 12 AM		
	12 AM To 8 AM	Existing Average Space Temp.	Existing Average MBH	Space Heating Annual MMBtu	8 AM To 4 PM	Existing Average Space Temp.	Existing Average MBH	Space Heating Annual MMBtu	4 PM To 12 AM	Existing Average Space Temp.	Existing Average MBH	Space Heating Annual MMBtu
	Heating Hours				Heating Hours				Heating Hours			
95 / 99	0	62 °F	0	0	0	62 °F	0	0	0	62 °F	0	0
90 / 94	0	62 °F	0	0	0	62 °F	0	0	0	62 °F	0	0
85 / 89	0	62 °F	0	0	1	62 °F	0	0	0	62 °F	0	0
80 / 84	0	62 °F	0	0	2	62 °F	0	0	1	62 °F	0	0
75 / 79	0	62 °F	0	0	5	62 °F	0	0	3	62 °F	0	0
70 / 74	4	62 °F	0	0	8	62 °F	0	0	9	62 °F	0	0
65 / 69	7	62 °F	0	0	12	62 °F	0	0	19	62 °F	0	0
60 / 64	21	62 °F	0	0	19	62 °F	0	0	33	62 °F	0	0
55 / 59	35	62 °F	11	0	26	62 °F	11	0	52	62 °F	11	1
50 / 54	55	62 °F	22	1	33	62 °F	22	1	70	62 °F	22	2
45 / 49	73	62 °F	34	2	40	62 °F	34	1	94	62 °F	34	3
40 / 44	105	62 °F	45	5	59	62 °F	45	3	139	62 °F	45	6
35 / 39	165	62 °F	56	9	64	62 °F	56	4	197	62 °F	56	11
30 / 34	220	62 °F	67	15	60	62 °F	67	4	216	62 °F	67	15
25 / 29	168	62 °F	78	13	42	62 °F	78	3	150	62 °F	78	12
20 / 24	130	62 °F	90	12	27	62 °F	90	2	106	62 °F	90	9
15 / 19	88	62 °F	101	9	18	62 °F	101	2	71	62 °F	101	7
10 / 14	68	62 °F	112	8	9	62 °F	112	1	44	62 °F	112	5
5 / 9	53	62 °F	123	6	5	62 °F	123	1	25	62 °F	123	3
0 / 4	30	62 °F	134	4	2	62 °F	134	0	7	62 °F	134	1
-5 / -1	11	62 °F	146	2	1	62 °F	146	0	3	62 °F	146	0
-10 / -6	6	62 °F	157	1	0	62 °F	157	0	1	62 °F	157	0
-15 / -11	2	62 °F	168	0	0	62 °F	168	0	0	62 °F	168	0
-20 / -16	1	62 °F	179	0	0	62 °F	179	0	0	62 °F	179	0
<b>Totals</b>	<b>1,241</b>			<b>88</b>	<b>432</b>			<b>22</b>	<b>1,242</b>			<b>75</b>

**Town Of Concord**

**ECM #2 - EMS Installation- Improved Temperature Control - Annual Energy Savings Estimate**

#### IV. Proposed Control System - Estimated Annual Heating Energy Usage - Occupied Hours

<b>Building:</b> 135 Keyes Road (Garage Section)
<b>Weather Data Location:</b> Bedford, Massachusetts

Outside Air Temp. Bin Deg. F	Daily Time Period	Heating Energy Usage 12 AM To 8 AM			Daily Time Period	Heating Energy Usage 8 AM To 4 PM			Daily Time Period	Heating Energy Usage 4 PM To 12 AM		
	12 AM To 8 AM	Proposed Average Space Temp.	Proposed Average MBH	Space Heating Annual MMBtu	8 AM To 4 PM	Proposed Average Space Temp.	Proposed Average MBH	Space Heating Annual MMBtu	4 PM To 12 AM	Proposed Average Space Temp.	Proposed Average MBH	Space Heating Annual MMBtu
	Heating Hours				Heating Hours				Heating Hours			
95 / 99	0	62 °F	0	0	0	62 °F	0	0	0	62 °F	0	0
90 / 94	0	62 °F	0	0	0	62 °F	0	0	0	62 °F	0	0
85 / 89	0	62 °F	0	0	2	62 °F	0	0	0	62 °F	0	0
80 / 84	0	62 °F	0	0	5	62 °F	0	0	0	62 °F	0	0
75 / 79	0	62 °F	0	0	13	62 °F	0	0	0	62 °F	0	0
70 / 74	0	62 °F	0	0	19	62 °F	0	0	1	62 °F	0	0
65 / 69	1	62 °F	0	0	29	62 °F	0	0	2	62 °F	0	0
60 / 64	2	62 °F	0	0	46	62 °F	0	0	4	62 °F	0	0
55 / 59	4	62 °F	0	0	65	62 °F	0	0	6	62 °F	0	0
50 / 54	6	62 °F	22	0	84	62 °F	22	2	8	62 °F	22	0
45 / 49	8	62 °F	34	0	100	62 °F	34	3	10	62 °F	34	0
40 / 44	11	62 °F	45	1	146	62 °F	45	7	15	62 °F	45	1
35 / 39	18	62 °F	56	1	160	62 °F	56	9	21	62 °F	56	1
30 / 34	24	62 °F	67	2	151	62 °F	67	10	23	62 °F	67	2
25 / 29	18	62 °F	78	1	106	62 °F	78	8	16	62 °F	78	1
20 / 24	14	62 °F	90	1	67	62 °F	90	6	12	62 °F	90	1
15 / 19	10	62 °F	101	1	45	62 °F	101	5	8	62 °F	101	1
10 / 14	7	62 °F	112	1	23	62 °F	112	3	5	62 °F	112	1
5 / 9	6	62 °F	123	1	11	62 °F	123	1	3	62 °F	123	0
0 / 4	3	62 °F	134	0	4	62 °F	134	1	1	62 °F	134	0
-5 / -1	1	62 °F	146	0	1	62 °F	146	0	0	62 °F	146	0
-10 / -6	1	62 °F	157	0	0	62 °F	157	0	0	62 °F	157	0
-15 / -11	0	62 °F	168	0	0	62 °F	168	0	0	62 °F	168	0
-20 / -16	0	62 °F	179	0	0	62 °F	179	0	0	62 °F	179	0
Totals	135			9	1,079			54	135			8

**Town Of Concord** **135 Keyes Road (Garage Section)**  
**ECM #2 - EMS Installation- Improved Temperature Control - Annual Energy Savings Estimate**

#### V. Proposed Control System - Estimated Annual Heating Energy Usage - Unoccupied Hours

<b>Building:</b> 135 Keyes Road (Garage Section)
<b>Weather Data Location:</b> Bedford, Massachusetts

Outside Air Temp. Bin Deg. F	Daily Time Period	Heating Energy Usage 12 AM To 8 AM			Daily Time Period	Heating Energy Usage 8 AM To 4 PM			Daily Time Period	Heating Energy Usage 4 PM To 12 AM		
	12 AM To 8 AM	Proposed Average Space Temp.	Proposed Average MBH	Space Heating Annual MMBtu	8 AM To 4 PM	Proposed Average Space Temp.	Proposed Average MBH	Space Heating Annual MMBtu	4 PM To 12 AM	Proposed Average Space Temp.	Proposed Average MBH	Space Heating Annual MMBtu
	Heating Hours				Heating Hours				Heating Hours			
95 / 99	0	55 °F	0	0	0	55 °F	0	0	0	55 °F	0	0
90 / 94	0	55 °F	0	0	0	55 °F	0	0	0	55 °F	0	0
85 / 89	0	55 °F	0	0	1	55 °F	0	0	0	55 °F	0	0
80 / 84	0	55 °F	0	0	2	55 °F	0	0	1	55 °F	0	0
75 / 79	0	55 °F	0	0	5	55 °F	0	0	4	55 °F	0	0
70 / 74	4	55 °F	0	0	8	55 °F	0	0	10	55 °F	0	0
65 / 69	8	55 °F	0	0	12	55 °F	0	0	21	55 °F	0	0
60 / 64	23	55 °F	0	0	19	55 °F	0	0	37	55 °F	0	0
55 / 59	38	55 °F	0	0	26	55 °F	0	0	57	55 °F	0	0
50 / 54	61	55 °F	7	0	33	55 °F	7	0	78	55 °F	7	1
45 / 49	81	55 °F	18	1	40	55 °F	18	1	104	55 °F	18	2
40 / 44	116	55 °F	29	3	59	55 °F	29	2	154	55 °F	29	4
35 / 39	183	55 °F	40	7	64	55 °F	40	3	219	55 °F	40	9
30 / 34	244	55 °F	51	13	60	55 °F	51	3	240	55 °F	51	12
25 / 29	186	55 °F	63	12	42	55 °F	63	3	167	55 °F	63	10
20 / 24	144	55 °F	74	11	27	55 °F	74	2	117	55 °F	74	9
15 / 19	98	55 °F	85	8	18	55 °F	85	2	78	55 °F	85	7
10 / 14	76	55 °F	96	7	9	55 °F	96	1	49	55 °F	96	5
5 / 9	58	55 °F	107	6	5	55 °F	107	0	28	55 °F	107	3
0 / 4	33	55 °F	119	4	2	55 °F	119	0	8	55 °F	119	1
-5 / -1	12	55 °F	130	2	1	55 °F	130	0	4	55 °F	130	0
-10 / -6	6	55 °F	141	1	0	55 °F	141	0	1	55 °F	141	0
-15 / -11	3	55 °F	152	0	0	55 °F	152	0	0	55 °F	152	0
-20 / -16	1	55 °F	163	0	0	55 °F	163	0	0	55 °F	163	0
Totals	1,376			76	432			16	1,377			63

**Town Of Concord                                      135 Keyes Road (Garage Section And Office Section)**  
**ECM #2 - EMS Installation- Improved Temperature Control - Annual Energy Savings Estimate**

**VI. Proposed Control System - Estimated Annual Fuel Energy Savings**

Annual Heating Energy Savings (Therms)						
<u><b>Garage Section</b></u>						
		Annual Space Heating Energy Use			Percent	
		Existing	Proposed	Saved	Saved	
	Total Space Heating End-Use MMBtu	288	228	61	21%	
	Space Heating End-Use Btu/SF/Year	59,410	46,932	12,478		
Annual Space Heating Natural Gas Usage						
	Space Heating System Efficiency:	82%			Percent	
		Existing	Proposed	Saved	Saved	
	Total Space Heating Input Therms	3,514	2,776	738	21%	
	Space Input Btu/SF/Year	72,451	57,234	15,217		
<u><b>Office Section And Building Totals</b></u>						
	Office Section - Square Footage				4,850	
	Space Heating Efficiency - Gas Heat				82%	
	Estimated Existing Btu/Sf/Year				45,000	
	Estimated Existing Therms				2,662	
	Estimated Proposed Btu/Sf/Year				35,000	
	Estimated Proposed Therms				2,070	
	Estimated Therms Saved - Improved Control With EMS				591	
	Estimated Therms Saved - Demand-Controlled Ventilation				133	
	Garage Section Annual Therms Saved				738	
	Total Building Annual Therms Saved				<u>1,462</u>	

**Town Of Concord                                      135 Keyes Road (Garage Section And Office Section)**  
**ECM #2 - EMS Installation- Improved Temperature Control - Annual Energy Savings Estimate**

**VII. Proposed Control System - Estimated Annual Electrical Energy Savings**

Annual Electrical Energy Savings (kWh)						
<u>Garage Section</u>		Total HP	Total kW	Existing Run Hours	Proposed Run Hours	
	Exhaust Fans	1	0.90	1,200	700	
	Unit Heater Fans	1/2	0.45	1,080	840	
		All Fans - Total Annual kWh Saved			555	
<u>Office Section And Building Totals</u>						
		Tons	kW/Ton	Total kW		
	Air Conditioning Load Factors	10	0.9	9.2		
		Existing	Proposed			
	Annual Scheduled Hours	1,697	1,256			
	Average Percent Load	60%	50%	Annual kWh Saved		
	Equivalent Full Load Hours	1,018	628			
	Average kW Per Ton	0.7	0.7			
	Annual Air Conditioning kWh	752	464		288	
	Estimated kWh Saved - Office Air Conditioning Control				288	
	Estimated kWh Saved - Demand-Controlled Ventilation				179	
	Garage Section Annual kWh Saved				555	
	Total Building Annual kWh Saved				<u>1,022</u>	

**Town Of Concord** **141 Keyes Road**  
**ECM #2 - EMS Installation - Annual Energy Savings Estimate**

					Estimated % Energy Savings		Annual Energy Units Saved			
Space Heating										
				Existing						
Estimated Annual Btu/SF/Year				41,041						
Building Heated Square Feet				9,841	New		New			
Heat Generation Efficiency				82%	EMS		EMS			Total
Estimated Annual Input MMBtu				493	15.0%		74			74
Space Cooling							Therms: 739			
				Existing						
Total Installed Tons				12						
Estimated Full Load Tons				11						
Estimated Annual Full-Load Hours				718						
Cooling Design kW Per Ton				1.41						
Cooling Average kW Per Ton				1.20	New		New			
Auxiliaries Average kW Per Ton				0.00	EMS		EMS			Total
Cooling - Total Annual kWh				20,954	15.0%		3,143			3,143
HVAC Fans										
				Existing						
Estimated Total Motor HP				1.25						
Estimated Total BHP				1.1						
Motors - Average Efficiency				70%						
Estimated Average Running Load Factor				1.00						
Total Fan Load - Average Input kW				1.2	New		New			
Estimated Annual Run- Hours				2,868	EMS		EMS			Total
Fans - Total Annual kWh				3,438	10.0%		344			344
Breakdown Of Btu Consumption Per Square Foot Existing And Proposed										
	Space Heating	Space Cooling	HVAC Fans	Total						
Existing	41,041	7,267	1,192	49,501						
Proposed	34,885	6,177	1,073	42,135						
Overall Percent Savings				15%						
Additional Savings With Demand-Controlled Ventilation:										
				Annual Therms	298					
				Annual kWh	617					



## ECM #2 - EMS Installation - Annual Energy Savings Estimate

					Estimated % Energy Savings		Annual Energy Units Saved		
Space Heating									
				Existing					
Estimated Annual Btu/SF/Year				92,557					
Building Heated Square Feet				14,431	New EMS		New EMS		Total
Heat Generation Efficiency				80%					
Estimated Annual Input MMBtu				1,670	20.0%		334		334
Space Cooling							Therms: 3,339		
				Existing					
Total Installed Tons				36					
Estimated Full Load Tons				32					
Estimated Annual Full-Load Hours				718					
Cooling Design kW Per Ton				0.94					
Cooling Average kW Per Ton				0.80	New EMS		New EMS		Total
Auxiliaries Average kW Per Ton				0.00					
Cooling - Total Annual kWh				40,333	20.0%		8,067		8,067
HVAC Fans									
				Existing					
Estimated Total Motor HP				8.00					
Estimated Total BHP				7.2					
Motors - Average Efficiency				80%					
Estimated Average Running Load Factor				1.00					
Total Fan Load - Average Input kW				6.7	New EMS		New EMS		Total
Estimated Annual Run- Hours				5,256					
Fans - Total Annual kWh				35,289	15.0%		5,293		5,293
Breakdown Of Btu Consumption Per Square Foot Existing And Proposed									
	Space Heating	Space Cooling	HVAC Fans	Total					
Existing	92,557	9,539	8,346	110,442					
Proposed	74,046	7,631	7,094	88,771					
Overall Percent Savings				20%					

**Town Of Concord                                      West Concord Fire Station**  
**ECM #2 - EMS Installation- Improved Temperature Control - Annual Energy Savings Estimate**

**I. Heating System Capacity Data And Operating Parameters**

<u>Existing Space Heating Systems - Estimated Design Capacity Data</u>							<u>Daily/Weekly Occupancy Schedule</u>							
	Building Heated Floor Area - Square Feet		5,204				Scheduling Control In Place (Y/N)		N	(24 Hour Occupancy)				
	Estimated Peak Heating Load Factor - Btu/Hr/SF		36.0											
	Indoor Design Temperature		70 °F				Existing System Heating System "Occupied" Schedule		Percent Occupied Times By Daily Time Period					
	Outdoor Design Temperature		5 °F						12 AM	8 AM	4 PM			
	Estimated Building U*A Factor - Btu/Hour/Deg. F		2,882				Manual Control Only		To	To	To			
<u>Heating System Operating Setpoints - Existing And Proposed</u>								Start	End	8 AM	4 PM	12 AM		
			Existing	Proposed			Monday	12:00 AM	12:00 AM	100%	100%	100%		
							Tuesday	12:00 AM	12:00 AM	100%	100%	100%		
	Space Heating Outside Air "Lockout" Temperature		65 °F	55 °F			Wednesday	12:00 AM	12:00 AM	100%	100%	100%		
							Thursday	12:00 AM	12:00 AM	100%	100%	100%		
	Estimated Space Temperatures Maintained - Existing System						Friday	12:00 AM	12:00 AM	100%	100%	100%		
	Outside Air Temperature Range	Occupied Hours			Unocc. Hours			Saturday	12:00 AM	12:00 AM	100%	100%	100%	
		12 AM	8 AM	4 PM				Sunday	12:00 AM	12:00 AM	100%	100%	100%	
		To	To	To				Annual Total			100%	100%	100%	
		8 AM	4 PM	12 AM				Annual Occupied Hours Per Period			2,918	2,916	2,920	
		0 °F To 30 °F	71 °F	72 °F		71 °F	70 °F	Total Annual Occupied Hours			8,754	100%		
		30 °F To 40 °F	72 °F	73 °F		72 °F	70 °F							
	40 °F To 70 °F	72 °F	73 °F	72 °F	70 °F									
							Proposed System Heating System "Occupied" Schedule		Percent Occupied Times By Daily Time Period					
			Occupied	Unocc.					12 AM	8 AM	4 PM			
	Proposed Average Space Temperature With EMS				65 °F	65 °F			To	To	To			
								Start	End	8 AM	4 PM	12 AM		
<u>Annual Months Of Heating System Operation</u>							Monday	12:00 AM	12:00 AM	100%	100%	100%		
							Tuesday	12:00 AM	12:00 AM	100%	100%	100%		
	Month	Space Heating Enabled	Month	Space Heating Enabled			Wednesday	12:00 AM	12:00 AM	100%	100%	100%		
							Thursday	12:00 AM	12:00 AM	100%	100%	100%		
							Friday	12:00 AM	12:00 AM	100%	100%	100%		
							Saturday	12:00 AM	12:00 AM	100%	100%	100%		
							Sunday	12:00 AM	12:00 AM	100%	100%	100%		
							Annual Total			100%	100%	100%		
	January	100%	July	0%			Annual Occupied Hours Per Period			2,918	2,916	2,920		
	February	100%	August	0%			Total Annual Occupied Hours			8,754	100%			
	March	100%	September	0%										
	April	50%	October	50%										
	May	0%	November	100%										
	June	0%	December	100%										

**Town Of Concord                                      West Concord Fire Station**  
**ECM #2 - EMS Installation- Improved Temperature Control - Annual Energy Savings Estimate**

**II. Existing Control System - Estimated Annual Heating Energy Usage - Occupied Hours**

<b>Building:</b> West Concord Fire Station
<b>Weather Data Location:</b> Bedford, Massachusetts

Outside Air Temp. Bin Deg. F	Daily Time Period	Heating Energy Usage 12 AM To 8 AM			Daily Time Period	Heating Energy Usage 8 AM To 4 PM			Daily Time Period	Heating Energy Usage 4 PM To 12 AM		
	12 AM To 8 AM	Existing Average Space Temp.	Existing Average MBH	Space Heating Annual MMBtu	8 AM To 4 PM	Existing Average Space Temp.	Existing Average MBH	Space Heating Annual MMBtu	4 PM To 12 AM	Existing Average Space Temp.	Existing Average MBH	Space Heating Annual MMBtu
	Heating Hours				Heating Hours				Heating Hours			
95 / 99	0	72 °F	0	0	0	73 °F	0	0	0	72 °F	0	0
90 / 94	0	72 °F	0	0	0	73 °F	0	0	0	72 °F	0	0
85 / 89	0	72 °F	0	0	1	73 °F	0	0	0	72 °F	0	0
80 / 84	0	72 °F	0	0	2	73 °F	0	0	0	72 °F	0	0
75 / 79	0	72 °F	0	0	9	73 °F	0	0	1	72 °F	0	0
70 / 74	0	72 °F	0	0	15	73 °F	0	0	4	72 °F	0	0
65 / 69	2	72 °F	0	0	31	73 °F	0	0	14	72 °F	0	0
60 / 64	15	72 °F	29	0	54	73 °F	32	2	29	72 °F	29	1
55 / 59	31	72 °F	43	1	84	73 °F	46	4	52	72 °F	43	2
50 / 54	57	72 °F	58	3	115	73 °F	61	7	77	72 °F	58	4
45 / 49	81	72 °F	72	6	139	73 °F	75	10	111	72 °F	72	8
40 / 44	123	72 °F	86	11	205	73 °F	89	18	167	72 °F	86	14
35 / 39	199	72 °F	101	20	225	73 °F	104	23	240	72 °F	101	24
30 / 34	267	72 °F	115	31	212	73 °F	118	25	263	72 °F	115	30
25 / 29	205	71 °F	127	26	148	72 °F	130	19	183	71 °F	127	23
20 / 24	159	71 °F	141	22	94	72 °F	144	14	129	71 °F	141	18
15 / 19	108	71 °F	156	17	63	72 °F	159	10	86	71 °F	156	13
10 / 14	83	71 °F	170	14	32	72 °F	173	6	54	71 °F	170	9
5 / 9	64	71 °F	184	12	16	72 °F	187	3	31	71 °F	184	6
0 / 4	36	71 °F	199	7	6	72 °F	202	1	9	71 °F	199	2
-5 / -1	13	71 °F	213	3	2	72 °F	216	0	4	71 °F	213	1
-10 / -6	7	71 °F	228	2	0	72 °F	231	0	1	71 °F	228	0
-15 / -11	3	71 °F	242	1	0	72 °F	245	0	0	71 °F	242	0
-20 / -16	1	71 °F	257	0	0	72 °F	259	0	0	71 °F	257	0
<b>Totals</b>	<b>1,451</b>			<b>176</b>	<b>1,450</b>			<b>142</b>	<b>1,453</b>			<b>157</b>

**Town Of Concord                                      West Concord Fire Station**  
**ECM #2 - EMS Installation- Improved Temperature Control - Annual Energy Savings Estimate**

**III. Existing Control System - Estimated Annual Heating Energy Usage - Unoccupied Hours**

<b>Building:</b> West Concord Fire Station
<b>Weather Data Location:</b> Bedford, Massachusetts

Outside Air Temp. Bin Deg. F	Daily Time Period	Heating Energy Usage 12 AM To 8 AM			Daily Time Period	Heating Energy Usage 8 AM To 4 PM			Daily Time Period	Heating Energy Usage 4 PM To 12 AM		
	12 AM To 8 AM	Existing Average Space Temp.	Existing Average MBH	Space Heating Annual MMBtu	8 AM To 4 PM	Existing Average Space Temp.	Existing Average MBH	Space Heating Annual MMBtu	4 PM To 12 AM	Existing Average Space Temp.	Existing Average MBH	Space Heating Annual MMBtu
	Heating Hours				Heating Hours				Heating Hours			
95 / 99	0	70 °F	0	0	0	70 °F	0	0	0	70 °F	0	0
90 / 94	0	70 °F	0	0	0	70 °F	0	0	0	70 °F	0	0
85 / 89	0	70 °F	0	0	0	70 °F	0	0	0	70 °F	0	0
80 / 84	0	70 °F	0	0	0	70 °F	0	0	0	70 °F	0	0
75 / 79	0	70 °F	0	0	0	70 °F	0	0	0	70 °F	0	0
70 / 74	0	70 °F	0	0	0	70 °F	0	0	0	70 °F	0	0
65 / 69	0	70 °F	0	0	0	70 °F	0	0	0	70 °F	0	0
60 / 64	0	70 °F	23	0	0	70 °F	23	0	0	70 °F	23	0
55 / 59	0	70 °F	37	0	0	70 °F	37	0	0	70 °F	37	0
50 / 54	0	70 °F	52	0	0	70 °F	52	0	0	70 °F	52	0
45 / 49	0	70 °F	66	0	0	70 °F	66	0	0	70 °F	66	0
40 / 44	0	70 °F	81	0	0	70 °F	81	0	0	70 °F	81	0
35 / 39	0	70 °F	95	0	0	70 °F	95	0	0	70 °F	95	0
30 / 34	0	70 °F	110	0	0	70 °F	110	0	0	70 °F	110	0
25 / 29	0	70 °F	124	0	0	70 °F	124	0	0	70 °F	124	0
20 / 24	0	70 °F	138	0	0	70 °F	138	0	0	70 °F	138	0
15 / 19	0	70 °F	153	0	0	70 °F	153	0	0	70 °F	153	0
10 / 14	0	70 °F	167	0	0	70 °F	167	0	0	70 °F	167	0
5 / 9	0	70 °F	182	0	0	70 °F	182	0	0	70 °F	182	0
0 / 4	0	70 °F	196	0	0	70 °F	196	0	0	70 °F	196	0
-5 / -1	0	70 °F	210	0	0	70 °F	210	0	0	70 °F	210	0
-10 / -6	0	70 °F	225	0	0	70 °F	225	0	0	70 °F	225	0
-15 / -11	0	70 °F	239	0	0	70 °F	239	0	0	70 °F	239	0
-20 / -16	0	70 °F	254	0	0	70 °F	254	0	0	70 °F	254	0
<b>Totals</b>	<b>0</b>			<b>0</b>	<b>0</b>			<b>0</b>	<b>0</b>			<b>0</b>

**Town Of Concord                                      West Concord Fire Station**  
**ECM #2 - EMS Installation- Improved Temperature Control - Annual Energy Savings Estimate**

**IV. Proposed Control System - Estimated Annual Heating Energy Usage - Occupied Hours**

<b>Building:</b> West Concord Fire Station
<b>Weather Data Location:</b> Bedford, Massachusetts

Outside Air Temp. Bin Deg. F	Daily Time Period	Heating Energy Usage 12 AM To 8 AM			Daily Time Period	Heating Energy Usage 8 AM To 4 PM			Daily Time Period	Heating Energy Usage 4 PM To 12 AM		
	12 AM To 8 AM	Proposed Average Space Temp.	Proposed Average MBH	Space Heating Annual MMBtu	8 AM To 4 PM	Proposed Average Space Temp.	Proposed Average MBH	Space Heating Annual MMBtu	4 PM To 12 AM	Proposed Average Space Temp.	Proposed Average MBH	Space Heating Annual MMBtu
	Heating Hours				Heating Hours				Heating Hours			
95 / 99	0	65 °F	0	0	0	65 °F	0	0	0	65 °F	0	0
90 / 94	0	65 °F	0	0	0	65 °F	0	0	0	65 °F	0	0
85 / 89	0	65 °F	0	0	1	65 °F	0	0	0	65 °F	0	0
80 / 84	0	65 °F	0	0	2	65 °F	0	0	0	65 °F	0	0
75 / 79	0	65 °F	0	0	9	65 °F	0	0	1	65 °F	0	0
70 / 74	0	65 °F	0	0	15	65 °F	0	0	4	65 °F	0	0
65 / 69	2	65 °F	0	0	31	65 °F	0	0	14	65 °F	0	0
60 / 64	15	65 °F	0	0	54	65 °F	0	0	29	65 °F	0	0
55 / 59	31	65 °F	0	0	84	65 °F	0	0	52	65 °F	0	0
50 / 54	57	65 °F	37	2	115	65 °F	37	4	77	65 °F	37	3
45 / 49	81	65 °F	52	4	139	65 °F	52	7	111	65 °F	52	6
40 / 44	123	65 °F	66	8	205	65 °F	66	14	167	65 °F	66	11
35 / 39	199	65 °F	81	16	225	65 °F	81	18	240	65 °F	81	19
30 / 34	267	65 °F	95	25	212	65 °F	95	20	263	65 °F	95	25
25 / 29	205	65 °F	110	22	148	65 °F	110	16	183	65 °F	110	20
20 / 24	159	65 °F	124	20	94	65 °F	124	12	129	65 °F	124	16
15 / 19	108	65 °F	138	15	63	65 °F	138	9	86	65 °F	138	12
10 / 14	83	65 °F	153	13	32	65 °F	153	5	54	65 °F	153	8
5 / 9	64	65 °F	167	11	16	65 °F	167	3	31	65 °F	167	5
0 / 4	36	65 °F	182	7	6	65 °F	182	1	9	65 °F	182	2
-5 / -1	13	65 °F	196	3	2	65 °F	196	0	4	65 °F	196	1
-10 / -6	7	65 °F	210	1	0	65 °F	210	0	1	65 °F	210	0
-15 / -11	3	65 °F	225	1	0	65 °F	225	0	0	65 °F	225	0
-20 / -16	1	65 °F	239	0	0	65 °F	239	0	0	65 °F	239	0
<b>Totals</b>	<b>1,451</b>			<b>148</b>	<b>1,450</b>			<b>109</b>	<b>1,453</b>			<b>128</b>

**Town Of Concord                                      West Concord Fire Station**  
**ECM #2 - EMS Installation- Improved Temperature Control - Annual Energy Savings Estimate**

**V. Proposed Control System - Estimated Annual Heating Energy Usage - Unoccupied Hours**

<b>Building:</b> West Concord Fire Station
<b>Weather Data Location:</b> Bedford, Massachusetts

Outside Air Temp. Bin Deg. F	Daily Time Period	Heating Energy Usage 12 AM To 8 AM			Daily Time Period	Heating Energy Usage 8 AM To 4 PM			Daily Time Period	Heating Energy Usage 4 PM To 12 AM		
	12 AM To 8 AM	Proposed Average Space Temp.	Proposed Average MBH	Space Heating Annual MMBtu	8 AM To 4 PM	Proposed Average Space Temp.	Proposed Average MBH	Space Heating Annual MMBtu	4 PM To 12 AM	Proposed Average Space Temp.	Proposed Average MBH	Space Heating Annual MMBtu
	Heating Hours				Heating Hours				Heating Hours			
95 / 99	0	65 °F	0	0	0	65 °F	0	0	0	65 °F	0	0
90 / 94	0	65 °F	0	0	0	65 °F	0	0	0	65 °F	0	0
85 / 89	0	65 °F	0	0	0	65 °F	0	0	0	65 °F	0	0
80 / 84	0	65 °F	0	0	0	65 °F	0	0	0	65 °F	0	0
75 / 79	0	65 °F	0	0	0	65 °F	0	0	0	65 °F	0	0
70 / 74	0	65 °F	0	0	0	65 °F	0	0	0	65 °F	0	0
65 / 69	0	65 °F	0	0	0	65 °F	0	0	0	65 °F	0	0
60 / 64	0	65 °F	0	0	0	65 °F	0	0	0	65 °F	0	0
55 / 59	0	65 °F	0	0	0	65 °F	0	0	0	65 °F	0	0
50 / 54	0	65 °F	37	0	0	65 °F	37	0	0	65 °F	37	0
45 / 49	0	65 °F	52	0	0	65 °F	52	0	0	65 °F	52	0
40 / 44	0	65 °F	66	0	0	65 °F	66	0	0	65 °F	66	0
35 / 39	0	65 °F	81	0	0	65 °F	81	0	0	65 °F	81	0
30 / 34	0	65 °F	95	0	0	65 °F	95	0	0	65 °F	95	0
25 / 29	0	65 °F	110	0	0	65 °F	110	0	0	65 °F	110	0
20 / 24	0	65 °F	124	0	0	65 °F	124	0	0	65 °F	124	0
15 / 19	0	65 °F	138	0	0	65 °F	138	0	0	65 °F	138	0
10 / 14	0	65 °F	153	0	0	65 °F	153	0	0	65 °F	153	0
5 / 9	0	65 °F	167	0	0	65 °F	167	0	0	65 °F	167	0
0 / 4	0	65 °F	182	0	0	65 °F	182	0	0	65 °F	182	0
-5 / -1	0	65 °F	196	0	0	65 °F	196	0	0	65 °F	196	0
-10 / -6	0	65 °F	210	0	0	65 °F	210	0	0	65 °F	210	0
-15 / -11	0	65 °F	225	0	0	65 °F	225	0	0	65 °F	225	0
-20 / -16	0	65 °F	239	0	0	65 °F	239	0	0	65 °F	239	0
<b>Totals</b>	<b>0</b>			<b>0</b>	<b>0</b>			<b>0</b>	<b>0</b>			<b>0</b>

**Town Of Concord                                  West Concord Fire Station**

**ECM #2 - EMS Installation- Improved Temperature Control - Annual Energy Savings Estimate**

## VI. Proposed Control System - Estimated Annual Fuel Energy Savings

[illegible]



**Town Of Concord    Beede Center**  
**ECM #2 - EMS Installation - Annual Energy Savings Estimate**

					Estimated % Energy Savings		Annual Energy Units Saved			
Space Heating										
			Existing							
		Estimated Annual Btu/SF/Year	127,412							
		Building Heated Square Feet	34,000		New EMS		New EMS	Total		
		Heat Generation Efficiency	88%							
		Estimated Annual Input MMBtu	4,923			3.0%				148
Space Cooling							Therms: 1,477			
			Existing							
		Total Installed Tons	40							
		Estimated Full Load Tons	36							
		Estimated Annual Full-Load Hours	1,279							
		Cooling Design kW Per Ton	1.04		New EMS		New EMS	Total		
		Cooling Average kW Per Ton	0.89							
		Auxiliaries Average kW Per Ton	0.00							
		Cooling - Total Annual kWh	88,878		20.0%			17,776	17,776	
HVAC Fans										
			Existing							
		Estimated Total Motor HP	10							
		Estimated Total BHP	8							
		Motors - Average Efficiency	88%		New EMS		New EMS	Total		
		Estimated Average Running Load Factor	1.00							
		Total Fan Load - Average Input kW	6.8							
		Estimated Annual Run- Hours	4,015		15.0%		4,084	4,084		
		Fans - Total Annual kWh	27,229							
Breakdown Of Btu Consumption Per Square Foot Existing And Proposed										
		Space Heating	Space Cooling	HVAC Fans	Total					
	Existing	127,412	8,922	2,733	139,067					
	Proposed	123,589	7,137	2,323	133,050					
	Overall Percent Savings				4%					
Additional Savings With Demand-Controlled Ventilation:										
		Annual Therms	1,046							
		Annual kWh	1,222							
</										

## Town Of Concord

### Hunt Recreation Facility

#### ECM #2 - EMS Installation - Annual Energy Savings Estimate

					Estimated % Energy Savings		Annual Energy Units Saved				
Space Heating											
	Existing										
	Estimated Annual Btu/SF/Year				60,042						
	Building Heated Square Feet				12,492		New EMS	New EMS	Total		
	Heat Generation Efficiency				70%						
	Estimated Annual Input MMBtu				1,071		20.0%		214	214	
Space Cooling							Therms: 2,143				
	Existing										
	Total Installed Tons				3						
	Estimated Full Load Tons				3						
	Estimated Annual Full-Load Hours				587						
	Cooling Design kW Per Ton				1.41		New EMS	New EMS	Total		
	Cooling Average kW Per Ton				1.20						
	Auxiliaries Average kW Per Ton				0.00						
	Cooling - Total Annual kWh				4,141		15.0%		621	621	
HVAC Fans											
	Existing										
	Estimated Total Motor HP				9.2						
	Estimated Total BHP				8.2						
	Motors - Average Efficiency				75%		New EMS	New EMS	Total		
	Estimated Average Running Load Factor				1.00						
	Total Fan Load - Average Input kW				8.2						
	Estimated Annual Run- Hours				4,015						
	Fans - Total Annual kWh				32,911		25.0%		8,228	8,228	
Breakdown Of Btu Consumption Per Square Foot Existing And Proposed											
	Space Heating	Space Cooling	HVAC Fans	Total							
Existing	60,042	1,131	8,992	70,166							
Proposed	48,034	962	6,744	55,739							
Overall Percent Savings				21%							

## Demand-Controlled Ventilation Various Buildings

### **I. Demand-Controlled Ventilation - Cooling Season Estimated Annual Energy Savings**

[illegible]

## Demand-Controlled Ventilation Various Buildings

## **II. Demand-Controlled Ventilation - Heating Season Estimated Annual Energy Savings**

[illegible]

**Town Of Concord**  
**ECM #2 - Energy Savings Analysis**

**III. Space Cooling Season - Operating Parameters And Setpoints**

Base Data	
Fresh Air CFM:	1,000
DX Cooling System EER:	9.5

Space Conditions - Cooling	
Occupied Space Cooling Temperature Setpoint:	73 °F
Estimated Maximum Space Relative Humidity:	50% RH
Estimated Maximum Space Air Enthalpy:	27.1 Btu/Lb

Estimated Condenser Relief		
Design Condensing Air Temperature: 95 °F		
% kW Per Ton Change Per Degree Change In OAT: 1.5%		
	OAT	kW/Ton
kW Per Ton - Minimum	70 °F	0.79
kW Per Ton - Maximum	100 °F	1.36

**V. Summary Of Calculations - Cooling kWh Per 1,000 CFM Fresh Air By Daily Time Period**

Daily Time Period	Total Fresh Air Cooling kWh Per 1,000 CFM
12 AM - 8 AM	116
8 AM - 4 PM	1,327
4 Pm - 12 AM	504
<b>Total:</b>	<b>1,947</b>

**IV. Estimated Cooling Energy Required To Cool Ventilation Air To Space Conditions**

Daily Time Period	OAT Range	OAT DB	OAT WB	OAT Enth.	Hours In Range	Average OA Cooling Load Tons	Average Cooling kW Per Ton	Total Cooling kWh For Fresh Air
12 AM to 8 AM	95 / 99	97 °F	74 °F	37.35	0	3.8	1.30	0
	90 / 94	92 °F	74 °F	37.15	0	3.8	1.21	0
	85 / 89	87 °F	72 °F	35.28	0	3.1	1.11	0
	80 / 84	82 °F	69 °F	32.74	3	2.1	1.02	6
	75 / 79	77 °F	66 °F	30.75	27	1.4	0.92	34
	70 / 74	72 °F	64 °F	29.13	119	0.8	0.83	75
	65 / 69	67 °F	61 °F	26.80	221	0.0	0.79	0
	60 / 64	62 °F	56 °F	24.07	262	0.0	0.79	0
8 AM to 4 PM	55 / 59	57 °F	52 °F	21.58	271	0.0	0.79	0
	95 / 99	97 °F	74 °F	37.35	3	3.8	1.30	15
	90 / 94	92 °F	74 °F	37.15	26	3.8	1.21	118
	85 / 89	87 °F	72 °F	35.28	89	3.1	1.11	304
	80 / 84	82 °F	69 °F	32.74	190	2.1	1.02	409
	75 / 79	77 °F	66 °F	30.75	249	1.4	0.92	316
	70 / 74	72 °F	64 °F	29.13	260	0.8	0.83	165
	65 / 69	67 °F	61 °F	26.80	230	0.0	0.79	0
4 PM to 12 AM	60 / 64	62 °F	56 °F	24.07	222	0.0	0.79	0
	55 / 59	57 °F	52 °F	21.58	218	0.0	0.79	0
	95 / 99	97 °F	74 °F	37.35	0	3.8	1.30	0
	90 / 94	92 °F	74 °F	37.15	4	3.8	1.21	18
	85 / 89	87 °F	72 °F	35.28	17	3.1	1.11	58
	80 / 84	82 °F	69 °F	32.74	60	2.1	1.02	129
	75 / 79	77 °F	66 °F	30.75	129	1.4	0.92	164
	70 / 74	72 °F	64 °F	29.13	213	0.8	0.83	135
	65 / 69	67 °F	61 °F	26.80	260	0.0	0.79	0
	60 / 64	62 °F	56 °F	24.07	253	0.0	0.79	0
	55 / 59	57 °F	52 °F	21.58	247	0.0	0.79	0
<b>Total:</b>								<b>1,947</b>

**Town Of Concord**  
**ECM #2 - Energy Savings Analysis**

**VI. Space Heating Season - Operating Parameters And Setpoints**

Base Data	
Fresh Air CFM:	1,000
Heating System Efficiency:	80%

Space Conditions - Heating	
Occupied Space Heating Temperature Setpoint:	70 °F

**VIII. Summary Of Calculations - Heating MMBtu Per 1,000 CFM Fresh Air By Daily Time Period**

Daily Time Period	Total Fresh Air Heating MMBtu Per 1,000 CFM
12 AM - 8 AM	83
8 AM - 4 PM	54
4 Pm - 12 AM	68
<b>Total:</b>	<b>206</b>

**VII. Estimated Fuel Energy Required To Heat Ventilation Air To Space Conditions**

Daily Time Period	OAT Range	OAT DB	Hours In Range	Average OA Heating Load MBH	Heating System Efficiency	Total Heating MMBtu For Fresh Air
12 AM to 8 AM	45 / 49					
	40 / 44	42 °F	240	30.2	0.80	9.1
	35 / 39	37 °F	274	35.6	0.80	12.2
	30 / 34	32 °F	310	41.0	0.80	15.9
	25 / 29	27 °F	219	46.4	0.80	12.7
	20 / 24	22 °F	161	51.8	0.80	10.4
	15 / 19	17 °F	108	57.2	0.80	7.7
	10 / 14	12 °F	83	62.6	0.80	6.5
	5 / 9	7 °F	64	68.0	0.80	5.4
	0 / 4	2 °F	36	73.4	0.80	3.3
8 AM to 4 PM	45 / 49					
	40 / 44	42 °F	237	30.2	0.80	9.0
	35 / 39	37 °F	234	35.6	0.80	10.4
	30 / 34	32 °F	214	41.0	0.80	11.0
	25 / 29	27 °F	148	46.4	0.80	8.6
	20 / 24	22 °F	94	51.8	0.80	6.1
	15 / 19	17 °F	63	57.2	0.80	4.5
	10 / 14	12 °F	32	62.6	0.80	2.5
	5 / 9	7 °F	16	68.0	0.80	1.4
	0 / 4	2 °F	6	73.4	0.80	0.6
4 PM to 12 AM	45 / 49					
	40 / 44	42 °F	238	30.2	0.80	9.0
	35 / 39	37 °F	275	35.6	0.80	12.3
	30 / 34	32 °F	276	41.0	0.80	14.2
	25 / 29	27 °F	185	46.4	0.80	10.7
	20 / 24	22 °F	129	51.8	0.80	8.4
	15 / 19	17 °F	86	57.2	0.80	6.2
	10 / 14	12 °F	54	62.6	0.80	4.2
	5 / 9	7 °F	31	68.0	0.80	2.6
	0 / 4	2 °F	9	73.4	0.80	0.8
<b>Total:</b>						<b>206</b>

**ECM #2 - Energy Management System Installation & Upgrade**  
**Opinion Of Probable Construction Cost**

Building/System	Estimated Quantity Input & Output Points	Estimated Unit Cost Per Point	New EMS Points Base Cost	Other Installation & Engineering Costs			Total Construction Cost
				New Zone Valve Installations	Retro Commissioning Existing Systems	Allowance Miscellaneous Controls Repairs	
<b>Concord Town House</b>							
Boiler Plant	14	\$ 600	\$ 8,400				
Chiller Plant	8	\$ 600	\$ 4,800				
Unit Heaters	16	\$ 400	\$ 6,400				
Fan Coil Units	136	\$ 200	\$ 27,200				
Air Handling Units	24	\$ 500	\$ 12,000				
Exhaust Fans	4	\$ 400	\$ 1,600				
Outside Temperature/Humidity	2	\$ 600	\$ 1,200				
Miscellaneous	8	\$ 400	\$ 3,200				
<b>Total</b>	<b>212</b>		<b>\$ 64,800</b>		<b>\$ 4,000</b>	<b>\$ 2,000</b>	<b>\$ 70,800</b>
<b>Harvey Wheeler Center</b>							
Space CO2 Sensors	12	\$ 1,000	\$ 12,000				
<b>Total</b>	<b>12</b>		<b>\$ 12,000</b>		<b>\$ 7,000</b>	<b>\$ 5,000</b>	<b>\$ 24,000</b>
<b>Public Works - 133 Keyes</b>							
Boiler System	6	\$ 800	\$ 4,800				
Office Wing AC Units	16	\$ 500	\$ 8,000				
Makeup Air Units	16	\$ 400	\$ 6,400				
Waste Oil Heater	4	\$ 400	\$ 1,600				
Unit Heaters - Bays	20	\$ 400	\$ 8,000				
Exhaust Fans - Bays	14	\$ 400	\$ 5,600				
Outside Temperature	1	\$ 600	\$ 600				
Miscellaneous	8	\$ 400	\$ 3,200				
<b>Total</b>	<b>85</b>		<b>\$ 38,200</b>			<b>\$ 2,000</b>	<b>\$ 40,200</b>
<b>Water/Sewer - 135 Keyes</b>							
New Rooftop Units - Offices	24	\$ 500	\$ 12,000				
Unit Heaters - Bays	6	\$ 500	\$ 3,000				
Exhaust Fans - Bays	2	\$ 500	\$ 1,000				
Electric Baseboard	2	\$ 500	\$ 1,000				
Outside Temperature/Humidity	2	\$ 600	\$ 1,200				
Miscellaneous	4	\$ 400	\$ 1,600				
<b>Total</b>	<b>40</b>		<b>\$ 19,800</b>			<b>\$ 2,000</b>	<b>\$ 21,800</b>



**ECM #2 - Energy Management System Installation & Upgrade**  
**Opinion Of Probable Construction Cost (Continued)**

Building/System	Estimated Quantity Input & Output Points	Estimated Unit Cost Per Point	New EMS Points Base Cost	Other Installation & Engineering Costs			Total Construction Cost
				New Zone Valve Installations	Retro Commissioning Existing Systems	Allowance Miscellaneous Controls Repairs	
<b>Planning - 141 Keyes</b>							
Boiler Plant	10	\$ 800	\$ 8,000				
Unit Heaters	16	\$ 500	\$ 8,000				
VAV Boxes & Reheat Coils	28	\$ 300	\$ 8,400				
Air Handling Units	24	\$ 400	\$ 9,600				
Exhaust Fans	4	\$ 400	\$ 1,600				
Outside Temperature/Humidity	2	\$ 600	\$ 1,200				
Miscellaneous	4	\$ 400	\$ 1,600				
<b>Total</b>	<b>88</b>		<b>\$ 30,400</b>			<b>\$ 2,000</b>	<b>\$ 32,400</b>
<b>Police &amp; Fire Station</b>							
Boiler Plant	10	\$ 800	\$ 8,000				
Existing Zone Valves	4	\$ 400	\$ 1,600				
New Zone Valves	8	\$ 400	\$ 3,200	\$ 9,600			
Bays - Unit Heaters	8	\$ 400	\$ 3,200				
Unit Heaters	12	\$ 400	\$ 4,800				
Split System AC Units	24	\$ 400	\$ 9,600				
Packaged AC Units	32	\$ 400	\$ 12,800				
Heating & Ventilating Units	12	\$ 400	\$ 4,800				
Outside Temperature	1	\$ 600	\$ 600				
Miscellaneous	8	\$ 400	\$ 3,200				
<b>Total</b>	<b>119</b>		<b>\$ 51,800</b>	<b>\$ 9,600</b>		<b>\$ 2,000</b>	<b>\$ 63,400</b>
<b>West Concord Fire Station</b>							
Boiler Plant	6	\$ 800	\$ 4,800				
Unit Heaters	8	\$ 500	\$ 4,000				
Existing Zone Valves	4	\$ 500	\$ 2,000				
New Zone Valves	4	\$ 500	\$ 2,000	\$ 4,800			
AC Unit	6	\$ 400	\$ 2,400				
Outside Temperature	1	\$ 600	\$ 600				
<b>Total</b>	<b>29</b>		<b>\$ 15,800</b>	<b>\$ 4,800</b>		<b>\$ 1,000</b>	<b>\$ 21,600</b>

**ECM #2 - Energy Management System Installation & Upgrade**  
**Opinion Of Probable Construction Cost (Continued)**

Building/System	Estimated Quantity Input & Output Points	Estimated Unit Cost Per Point	New EMS Points Base Cost	Other Installation & Engineering Costs			Total Construction Cost
				New Zone Valve Installations	Retro Commissioning Existing Systems	Allowance Miscellaneous Controls Repairs	
<b>Beede Center</b>							
Packaged Rooftop AC Units	72	\$ 350	\$ 25,200				
Building Heating Pump	2	\$ 400	\$ 800				
Natatorium Space Temperature	1	\$ 400	\$ 400				
Natatorium Humidity	1	\$ 400	\$ 400				
Outside Temperature/Humidity	2	\$ 600	\$ 1,200				
<b>Total</b>	<b>78</b>		<b>\$ 28,000</b>			<b>\$ 1,000</b>	<b>\$ 29,000</b>
<b>Hunt Recreation Facility</b>							
Boiler Plant	6	\$ 800	\$ 4,800				
Heating & Ventilating Units	20	\$ 600	\$ 12,000				
AC Unit	6	\$ 300	\$ 1,800				
Reheat Coils	4	\$ 400	\$ 1,600				
Unit Heaters	16	\$ 400	\$ 6,400				
Exhaust Fans	4	\$ 400	\$ 1,600				
Perimeter Heat Zones	12	\$ 500	\$ 6,000				
Outside Temperature	1	\$ 600	\$ 600				
<b>Total</b>	<b>69</b>		<b>\$ 34,800</b>			<b>\$ 4,000</b>	<b>\$ 38,800</b>

ECM #2 Construction Cost Summary For All Buildings	Total Input & Output Points	Total System Cost	Total Cost Per Point
Concord Town House	212	\$ 70,800	\$ 334
Harvey Wheeler Center	12	\$ 24,000	\$ 2,000
Public Works - 133 Keyes	85	\$ 40,200	\$ 473
Water/Sewer - 135 Keyes	40	\$ 21,800	\$ 545
Planning - 141 Keyes	88	\$ 32,400	\$ 368
Police & Fire Station	119	\$ 63,400	\$ 533
West Concord Fire Station	29	\$ 21,600	\$ 745
Beede Center	78	\$ 29,000	\$ 372
Hunt Recreation Facility	69	\$ 38,800	\$ 562
<b>Totals:</b>	<b>732</b>	<b>\$ 342,000</b>	<b>\$ 467</b>

## **Appendix C – ECM #3**

**Town Of Concord - Police & Fire Station**  
**ECM #3 - Boiler Replacement - Existing System**

**I. Existing Hydronic Heating System Design Data And Operating Parameters**

<b><u>Boiler And Heating System Design Data</u></b>						<b><u>Heating System Operating Setpoints</u></b>					
Boiler Quantity: 1						Heating System "Lockout" Outside Air Temperature: 65 °F					
Manufacturer: Hydrotherm						Setback Control In Place? (Y/N): N					
Model #: MO-770A						Indoor Occupied Temperature Setpoint: 70 °F					
Boiler Fuel Type: Gas (Converted From Oil)						Indoor Unoccupied Temperature Setpoint: 55 °F					
Fuel Oil Input GPH: 5.5											
Rated Input Capacity - MBH: 759											
Rated Output Capacity - MBH: 630						<b><u>Estimated Boiler Efficiency Variation With Boiler Loading</u></b>					
Design Efficiency: 83% (Tested Recently)											
Estimated Lowest Seasonal Efficiency: 70%						Boiler Percent Load		Estimated Boiler Efficiency			
						100%		83%			
						20%		70%			
<b><u>Estimated Building U*A Factor And Boiler Loss Factors</u></b>											
Estimated Peak Load - Percent Of Rated Boiler Output: 50%				Square Footage	Peak Btu/Hr/SF						
Estimated Peak Load - MBH: 315				14,431	22						
Design Indoor Temperature: 70 °F											
Heating Design Outdoor Temperature: 7 °F											
Design U*A - Btu/Hr/Deg. F: 5,000											
Space Heating Load Supplied By				50 °F	25%						
Internal Gains - Percent VS OAT				0 °F	10%						
<b><u>Daily/Weekly Occupancy Schedule:</u></b>											
						<b><u>Annual Months Of Operation - Space Heating System:</u></b>					
Percent Occupied Times By Daily Time Period			12 AM To 8 AM	8 AM To 4 PM	4 PM To 12 AM						
Occ. Schedule	Start	End	8 AM	4 PM	12 AM		Month	Percent Time Enabled	Month	Percent Time Enabled	
Monday:	12:00 AM	12:00 AM	100%	100%	100%						
Tuesday:	12:00 AM	12:00 AM	100%	100%	100%		Jan	100%	Jul	0%	
Wednesday:	12:00 AM	12:00 AM	100%	100%	100%		Feb	100%	Aug	0%	
Thursday:	12:00 AM	12:00 AM	100%	100%	100%		Mar	100%	Sep	0%	
Friday:	12:00 AM	12:00 AM	100%	100%	100%		Apr	100%	Oct	50%	
Saturday:	12:00 AM	12:00 AM	100%	100%	100%		May	50%	Nov	100%	
Sunday:	12:00 AM	12:00 AM	100%	100%	100%		Jun	0%	Dec	100%	
Occupied Percentages - Annual Total			100%	100%	100%						

**Town Of Concord - Police & Fire Station**  
**ECM #3 - Boiler Replacement - Existing System**

**II. Existing Hydronic Heating System - Estimated Annual Energy Usage**

Outside Air Temp. Bin Deg. F	Total Annual System Hours	Occupied Operation Fuel Usage			Unoccupied Operation Fuel Usage		
		Total Annual Occupied Hours	Boiler Output Required MBH	Boiler Fuel Usage Annual Input MMBtu	Total Annual Unocc. Hours	Boiler Fuel Usage Average Input MBH	Boiler Fuel Usage Annual Input MMBtu
95 / 99	0	0	0	0	0	0	0
90 / 94	1	1	0	0	0	0	0
85 / 89	4	4	0	0	0	0	0
80 / 84	9	9	0	0	0	0	0
75 / 79	27	27	0	0	0	0	0
70 / 74	49	49	0	0	0	0	0
65 / 69	100	100	0	0	0	0	0
60 / 64	175	175	30	7	0	0	0
55 / 59	263	263	49	18	0	0	0
50 / 54	359	359	67	35	0	0	0
45 / 49	444	444	87	55	0	0	0
40 / 44	603	603	108	93	0	0	0
35 / 39	728	728	130	135	0	0	0
30 / 34	776	776	153	168	0	0	0
25 / 29	546	546	176	135	0	0	0
20 / 24	383	383	200	107	0	0	0
15 / 19	257	257	225	80	0	0	0
10 / 14	169	169	251	58	0	0	0
5 / 9	111	111	277	42	0	0	0
0 / 4	51	51	282	19	0	0	0
-5 / -1	19	19	283	7	0	0	0
-10 / -6	8	8	283	3	0	0	0
-15 / -11	3	3	283	1	0	0	0
-20 / -16	1	1	283	0	0	0	0
	<b>5,083</b>	<b>5,083</b>		<b>964</b>	<b>0</b>		<b>0</b>

**III. Estimated Annual Energy Usage -  
Existing Hydronic Heating System**

	Natural Gas MMBtu	Natural Gas Therms	
	964	9,635	

Actual Natural Gas Therms - Current Year:	14,060
Existing Total Fuel Btu/SF/Year:	97,429
<i>(Includes Domestic Hot Water Load)</i>	
Estimated Annual Natural Gas Therms - Domestic Hot Water:	1,020

**Town Of Concord - Police & Fire Station**  
**ECM #3 - Boiler Replacement - Proposed System**

**I. Existing Hydronic Heating System With New Condensing Gas-Fired Boiler - Design Data And Operating Parameters**

<u><b>Boiler And Heating System Design Data</b></u>					<u><b>Heating System Operating Setpoints</b></u>				
Boiler Quantity: 2					Heating System "Lockout" Outside Air Temperature: 60 °F				
Manufacturer: Viessmann					Setback Control In Place? (Y/N): N				
Model #: WB2 15-60					Indoor Occupied Temperature Setpoint: 70 °F				
Boiler Fuel Type: Gas					Indoor Unoccupied Temperature Setpoint: 55 °F				
Fuel Oil Input GPH:									
Rated Input Capacity - MBH: 460									
Rated Output Capacity - MBH: 410					<u><b>Estimated Boiler Efficiency Variation With Boiler Loading</b></u>				
Design Efficiency: 89%									
Estimated Highest Efficiency: 97% (Condensing Mode)									
<u><b>Estimated Building U*A Factor And Boiler Loss Factors</b></u>									
Estimated Peak Load - Percent Of Rated Boiler Output: 77%					Square Footage	Peak Btu/Hr/SF			
Estimated Peak Load - MBH: 315					14,431	22			
Design Indoor Temperature: 70 °F									
Heating Design Outdoor Temperature: 7 °F									
Design U*A - Btu/Hr/Deg. F: 5,000									
Space Heating Load Supplied By					50 °F	25%			
Internal Gains - Percent VS OAT					0 °F	10%			
<u><b>Daily/Weekly Occupancy Schedule:</b></u>									
<u><b>Annual Months Of Operation - Space Heating System:</b></u>									
Percent Occupied Times By Daily Time Period			12 AM To 8 AM	8 AM To 4 PM	4 PM To 12 AM				
Occ. Schedule	Start	End	8 AM	4 PM	12 AM				
Monday:	12:00 AM	12:00 AM	100%	100%	100%				
Tuesday:	12:00 AM	12:00 AM	100%	100%	100%	Month	Percent Time Enabled	Month	Percent Time Enabled
Wednesday:	12:00 AM	12:00 AM	100%	100%	100%	Jan	100%	Jul	0%
Thursday:	12:00 AM	12:00 AM	100%	100%	100%	Feb	100%	Aug	0%
Friday:	12:00 AM	12:00 AM	100%	100%	100%	Mar	100%	Sep	0%
Saturday:	12:00 AM	12:00 AM	100%	100%	100%	Apr	100%	Oct	50%
Sunday:	12:00 AM	12:00 AM	100%	100%	100%	May	50%	Nov	100%
Occupied Percentages - Annual Total			100%	100%	100%	Jun	0%	Dec	100%

**Town Of Concord - Police & Fire Station**  
**ECM #3 - Boiler Replacement - Proposed System**

**II. Existing Hydronic Heating System With New Condensing Gas-Fired Boiler -  
Estimated Annual Energy Usage**

Outside Air Temp. Bin Deg. F	Total Annual System Hours	Occupied Operation Fuel Usage			Unoccupied Operation Fuel Usage		
		Total Annual Occupied Hours	Boiler Output Required MBH	Boiler Fuel Usage Annual Input MMBtu	Total Annual Unocc. Hours	Boiler Fuel Usage Average Input MBH	Boiler Fuel Usage Annual Input MMBtu
95 / 99	0	0	0	0	0	0	0
90 / 94	1	1	0	0	0	0	0
85 / 89	4	4	0	0	0	0	0
80 / 84	9	9	0	0	0	0	0
75 / 79	27	27	0	0	0	0	0
70 / 74	49	49	0	0	0	0	0
65 / 69	100	100	0	0	0	0	0
60 / 64	175	175	0	0	0	0	0
55 / 59	263	263	49	13	0	0	0
50 / 54	359	359	67	25	0	0	0
45 / 49	444	444	87	40	0	0	0
40 / 44	603	603	108	67	0	0	0
35 / 39	728	728	130	98	0	0	0
30 / 34	776	776	153	122	0	0	0
25 / 29	546	546	176	99	0	0	0
20 / 24	383	383	200	79	0	0	0
15 / 19	257	257	225	60	0	0	0
10 / 14	169	169	251	44	0	0	0
5 / 9	111	111	277	32	0	0	0
0 / 4	51	51	282	15	0	0	0
-5 / -1	19	19	283	6	0	0	0
-10 / -6	8	8	283	2	0	0	0
-15 / -11	3	3	283	1	0	0	0
-20 / -16	1	1	283	0	0	0	0
	<b>5,083</b>	<b>5,083</b>		<b>702</b>	<b>0</b>		<b>0</b>

**III. Proposed Annual Energy Usage - Existing Hydronic Heating System  
With New High Efficiency Condensing Boiler**

	Natural Gas MMBtu	Natural Gas Therms	
	702	7,022	

**IV. Estimated Annual Fuel Units Saved**

		Natural Gas MMBtu	Natural Gas Therms	
	Existing	964	9,635	
	Proposed	702	7,022	
	Saved	261	2,614	
Percent Fuel Savings:		27%		



**Town Of Concord - West Concord Fire Station**  
**ECM #3 - Boiler Replacement - Existing System**

**I. Existing Steam Heating System Design Data And Operating Parameters**

<u><b>Boiler And Heating System Design Data</b></u>					<u><b>Heating System Operating Setpoints</b></u>						
Boiler Quantity: 2					Heating System "Lockout" Outside Air Temperature: 65 °F						
Manufacturer: Burnham					Setback Control In Place? (Y/N): N						
Model #: 408B					Indoor Occupied Temperature Setpoint: 70 °F						
Boiler Fuel Type: Gas					Indoor Unoccupied Temperature Setpoint: 55 °F						
Gas Input Per Boiler - MBH: 245.0											
Rated Total Input Capacity - MBH: 490											
Rated Total Output Capacity - MBH: 377					<u><b>Estimated Boiler Efficiency Variation With Boiler Loading</b></u>						
Design Efficiency: 77% (Estimated)											
Estimated Lowest Seasonal Efficiency: 58%											
<u><b>Estimated Building U*A Factor And Boiler Loss Factors</b></u>											
Estimated Peak Load - Percent Of Rated Boiler Output: 45%					Square	Peak					
					Footage	Btu/Hr/SF					
Estimated Peak Load - MBH: 170					5,204	33					
Design Indoor Temperature: 70 °F											
Heating Design Outdoor Temperature: 7 °F											
Design U*A - Btu/Hr/Deg. F: 2,695											
Space Heating Load Supplied By					50 °F	25%					
Internal Gains - Percent VS OAT					0 °F	10%					
<u><b>Daily/Weekly Occupancy Schedule:</b></u>					<u><b>Annual Months Of Operation -</b></u>						
					<u><b>Space Heating System:</b></u>						
Percent Occupied Times					12 AM	8 AM	4 PM				
By Daily Time Period					To	To	To				
Occ. Schedule					Start	End	8 AM	4 PM	12 AM		
Monday: 12:00 AM 12:00 AM					100%	100%	100%				
Tuesday: 12:00 AM 12:00 AM					100%	100%	100%				
Wednesday: 12:00 AM 12:00 AM					100%	100%	100%	Month	Percent Time Enabled	Month	Percent Time Enabled
Thursday: 12:00 AM 12:00 AM					100%	100%	100%	Jan	100%	Jul	0%
Friday: 12:00 AM 12:00 AM					100%	100%	100%	Feb	100%	Aug	0%
Saturday: 12:00 AM 12:00 AM					100%	100%	100%	Mar	100%	Sep	0%
Sunday: 12:00 AM 12:00 AM					100%	100%	100%	Apr	100%	Oct	50%
Occupied Percentages - Annual Total					100%	100%	100%	May	50%	Nov	100%
								Jun	0%	Dec	100%

**Town Of Concord - West Concord Fire Station  
ECM #3 - Boiler Replacement - Existing System**

**II. Existing Steam Heating System - Estimated Annual Energy Usage**

Outside Air Temp. Bin Deg. F	Total Annual System Hours	Occupied Operation Fuel Usage			Unoccupied Operation Fuel Usage		
		Total Annual Occupied Hours	Boiler Output Required MBH	Boiler Fuel Usage Annual Input MMBtu	Total Annual Unocc. Hours	Boiler Fuel Usage Average Input MBH	Boiler Fuel Usage Annual Input MMBtu
95 / 99	0	0	0	0	0	0	0
90 / 94	1	1	0	0	0	0	0
85 / 89	4	4	0	0	0	0	0
80 / 84	9	9	0	0	0	0	0
75 / 79	27	27	0	0	0	0	0
70 / 74	49	49	0	0	0	0	0
65 / 69	100	100	0	0	0	0	0
60 / 64	175	175	16	5	0	0	0
55 / 59	263	263	26	12	0	0	0
50 / 54	359	359	36	22	0	0	0
45 / 49	444	444	47	36	0	0	0
40 / 44	603	603	58	61	0	0	0
35 / 39	728	728	70	88	0	0	0
30 / 34	776	776	82	109	0	0	0
25 / 29	546	546	95	87	0	0	0
20 / 24	383	383	108	69	0	0	0
15 / 19	257	257	121	51	0	0	0
10 / 14	169	169	135	37	0	0	0
5 / 9	111	111	149	26	0	0	0
0 / 4	51	51	152	12	0	0	0
-5 / -1	19	19	153	5	0	0	0
-10 / -6	8	8	153	2	0	0	0
-15 / -11	3	3	153	1	0	0	0
-20 / -16	1	1	153	0	0	0	0
	<b>5,083</b>	<b>5,083</b>		<b>624</b>	<b>0</b>		<b>0</b>

**III. Estimated Annual Energy Usage -  
Existing Steam Heating System**

	Natural Gas MMBtu	Natural Gas Therms	
	624	6,240	

Actual Natural Gas Therms - Current Year:	7,973
Existing Total Fuel Btu/SF/Year:	153,209
<i>(Includes Domestic Hot Water Load)</i>	
Estimated Annual Natural Gas Therms -	
Domestic Hot Water:	960

**Town Of Concord - West Concord Fire Station  
ECM #3 - Boiler Replacement - Proposed System**

**I. Existing Steam Heating System With New Condensing Gas-Fired Boiler - Design Data And Operating Parameters**

<u><b>Boiler And Heating System Design Data</b></u>				<u><b>Heating System Operating Setpoints</b></u>			
Boiler Quantity: 2		Heating System "Lockout" Outside Air Temperature: 60 °F					
Manufacturer: Burnham		Setback Control In Place? (Y/N): N					
Model #: DR Series		Indoor Occupied Temperature Setpoint: 70 °F					
Boiler Fuel Type: Gas		Indoor Unoccupied Temperature Setpoint: 55 °F					
Gas Input Per Boiler - MBH: 200.0							
Rated Total Input Capacity - MBH: 400							
Rated Total Output Capacity - MBH: 320							
<u><b>Estimated Boiler Efficiency Variation With Boiler Loading</b></u>							
Design Efficiency: 80%							
Estimated Lowest Seasonal Efficiency: 78%							
		Boiler Percent Load	Estimated Boiler Efficiency				
		100%	80%				
		20%	78%				
<u><b>Estimated Building U*A Factor And Boiler Loss Factors</b></u>							
Estimated Peak Load - Percent Of Rated Boiler Output: 53%		Square Footage	Peak Btu/Hr/SF				
Estimated Peak Load - MBH: 170		5,204	33				
Design Indoor Temperature: 70 °F							
Heating Design Outdoor Temperature: 7 °F							
Design U*A - Btu/Hr/Deg. F: 2,695							
Space Heating Load Supplied By		50 °F	25%				
Internal Gains - Percent VS OAT		0 °F	10%				
<u><b>Daily/Weekly Occupancy Schedule:</b></u>							
<u><b>Annual Months Of Operation - Space Heating System:</b></u>							
Percent Occupied Times By Daily Time Period		12 AM To 8 AM	8 AM To 4 PM	4 PM To 12 AM			
Occ. Schedule	Start End	8 AM	4 PM	12 AM			
Monday:	12:00 AM 12:00 AM	100%	100%	100%			
Tuesday:	12:00 AM 12:00 AM	100%	100%	100%			
Wednesday:	12:00 AM 12:00 AM	100%	100%	100%			
Thursday:	12:00 AM 12:00 AM	100%	100%	100%			
Friday:	12:00 AM 12:00 AM	100%	100%	100%			
Saturday:	12:00 AM 12:00 AM	100%	100%	100%			
Sunday:	12:00 AM 12:00 AM	100%	100%	100%			
Occupied Percentages - Annual Total		100%	100%	100%			
Month	Percent Time Enabled	Month	Percent Time Enabled				
Jan	100%	Jul	0%				
Feb	100%	Aug	0%				
Mar	100%	Sep	0%				
Apr	100%	Oct	50%				
May	50%	Nov	100%				
Jun	0%	Dec	100%				

**Town Of Concord - West Concord Fire Station  
ECM #3 - Boiler Replacement - Proposed System**

**II. Existing Steam Heating System With New Condensing Gas-Fired Boiler -  
Estimated Annual Energy Usage**

Outside Air Temp. Bin Deg. F	Total Annual System Hours	Occupied Operation Fuel Usage			Unoccupied Operation Fuel Usage		
		Total Annual Occupied Hours	Boiler Output Required MBH	Boiler Fuel Usage Annual Input MMBtu	Total Annual Unocc. Hours	Boiler Fuel Usage Average Input MBH	Boiler Fuel Usage Annual Input MMBtu
95 / 99	0	0	0	0	0	0	0
90 / 94	1	1	0	0	0	0	0
85 / 89	4	4	0	0	0	0	0
80 / 84	9	9	0	0	0	0	0
75 / 79	27	27	0	0	0	0	0
70 / 74	49	49	0	0	0	0	0
65 / 69	100	100	0	0	0	0	0
60 / 64	175	175	0	0	0	0	0
55 / 59	263	263	26	9	0	0	0
50 / 54	359	359	36	17	0	0	0
45 / 49	444	444	47	27	0	0	0
40 / 44	603	603	58	45	0	0	0
35 / 39	728	728	70	65	0	0	0
30 / 34	776	776	82	82	0	0	0
25 / 29	546	546	95	66	0	0	0
20 / 24	383	383	108	53	0	0	0
15 / 19	257	257	121	40	0	0	0
10 / 14	169	169	135	29	0	0	0
5 / 9	111	111	149	21	0	0	0
0 / 4	51	51	152	10	0	0	0
-5 / -1	19	19	153	4	0	0	0
-10 / -6	8	8	153	2	0	0	0
-15 / -11	3	3	153	1	0	0	0
-20 / -16	1	1	153	0	0	0	0
	<b>5,083</b>	<b>5,083</b>		<b>469</b>	<b>0</b>		<b>0</b>

**III. Proposed Annual Energy Usage - Existing Steam Heating System  
With New High Efficiency Condensing Boiler**

	Natural Gas MMBtu	Natural Gas Therms	
	469	4,693	

**IV. Estimated Annual Fuel Units Saved**

		Natural Gas MMBtu	Natural Gas Therms	
	Existing	624	6,240	
	Proposed	469	4,693	
	Saved	155	1,548	
Percent Fuel Savings:		25%		

**Town of Concord Massachusetts**  
**ECM #3 - Boiler Replacements**  
**Opinion of Probable Construction Cost**

**ECM # 3**  
**Police & Fire Station**

Construction Item Description Material/Labor	Unit Price	Quantity	Total Cost
<b>Material Line Items</b>			
Condensing Boiler			\$ -
Viessman WB2 15 60 460 MBH Input	\$ 6,800	2	\$ 13,600
Primary Hot Water Pumps	\$ 1,500	2	\$ 3,000
In line circulators 1 HP	\$ 2,400	2	\$ 4,800
Boiler Stack	\$ 4,000	1	\$ 4,000
Air Separator Spriovent	\$ 1,800	1	\$ 1,800
Pipe & Misc. Material - Lump Sum	\$ 2,000	1	\$ 2,000
			\$ -
			\$ -
			\$ -
			\$ -
<b>Material - Subtotal Cost:</b>			<b>\$ 29,200</b>
<b>Labor Line Items</b>	<b>Per Hour</b>	<b>Hours</b>	
Demolition	Lump Sum		\$ 1,200
Housekeeping Pads	Lump Sum		\$ 800
Boiler Installation	Lump Sum		\$ 4,800
Piping	Lump Sum		\$ 2,000
Breeching & Stack	Lump Sum		\$ 3,200
Electrical	Lump Sum		\$ 900
			\$ -
			\$ -
			\$ -
<b>Labor - Subtotal Cost:</b>			<b>\$ 12,900</b>
<b>Total Construction Cost - Material And Labor:</b>			<b>\$ 42,100</b>
<b>Engineering Design - Percentage:</b>			<b>15%</b>
<b>Total Cost Including Design:</b>			<b>\$ 48,415</b>

**Note:**

This estimate does not include construction management costs or other costs that are internal to the Town of Concord.

Hazardous waste disposal costs and abatement costs are not included.

**Town of Concord Massachusetts**  
**ECM #3 - Boiler Replacements**  
**Opinion of Probable Construction Cost**

**ECM # 3**  
**West Concord Fire Station**

<b>Construction Item Description Material/Labor</b>	<b>Unit Price</b>	<b>Quantity</b>	<b>Total Cost</b>
<b>Material Line Items</b>			
Gas-Fired Steam Boiler			\$ -
Cast Iron Sectional 200 MBH Input	\$ 3,750	2	\$ 7,500
Boiler Stack - Lump Sum	\$ 4,000	1	\$ 4,000
Pipe & Misc. Material - Lump Sum	\$ 1,000	1	\$ 1,000
			\$ -
			\$ -
			\$ -
			\$ -
			\$ -
			\$ -
			\$ -
<b>Material - Subtotal Cost:</b>			<b>\$ 12,500</b>
<b>Labor Line Items</b>	<b>Per Hour</b>	<b>Hours</b>	
Demolition	Lump Sum		\$ 2,500
Housekeeping Pads	Lump Sum		\$ 1,200
Boiler Installation	Lump Sum		\$ 6,000
Piping	Lump Sum		\$ 1,000
Breeching & Stack	Lump Sum		\$ 4,200
Electrical	Lump Sum		\$ 500
			\$ -
			\$ -
			\$ -
<b>Labor - Subtotal Cost:</b>			<b>\$ 15,400</b>
<b>Total Construction Cost - Material And Labor:</b>			<b>\$ 27,900</b>
<b>Engineering Design - Percentage:</b>			<b>15%</b>
<b>Total Cost Including Design:</b>			<b>\$ 32,085</b>

**Note:**

This estimate does not include construction management costs or other costs that are internal to the Town of Concord.

Hazardous waste disposal costs and abatement costs are not included.

## **Appendix D – ECM #4 And ECM #5**



Town Of Concord                      Beede Center  
 ECM #4 - Pool Pumps - Variable Frequency Drives  
 ECM Summary

ECM Option	Annual kWh Saved	Cost Per kWh	Annual Cost Savings	Probable Construction Cost	Simple Payback
Premium Efficiency Motors Only	5,560	\$0.085	\$ 473	\$ 10,100	21.4
Variable Frequency Drives With New Premium Efficiency Motors	202,570	\$0.085	\$ 17,218	\$ 37,820	2.2
Variable Frequency Drives With Existing Motors	192,395	\$0.085	\$ 16,354	\$ 30,070	1.8

**ECM Opinion Of Probable Cost**

Pool Pump Motor	Pool	Motor HP	New Motor Cost	Motor Labor Cost	Motor Total Cost
1	Dive	20	\$2,100	\$750	\$2,850
2	Lap	25	\$2,500	\$750	\$3,250
3	Therapy	15	\$1,700	\$650	\$2,350
4	Childrens	7 1/2	\$1,000	\$650	\$1,650
<b>Total For New Premium Efficiency Motors:</b>					<b>\$10,100</b>

Pool Pump Motor	Pool	Motor HP	VFD Costs
1	Dive	20	\$5,940
2	Lap	25	\$7,280
4	Childrens	7 1/2	\$4,600
<b>Total For New VFD's:</b>			<b>\$17,820</b>
<b>Electrical Labor:</b>			<b>\$4,500</b>
<b>Startup:</b>			<b>\$1,750</b>
<b>Additional For Controls:</b>			<b>\$6,000</b>
<b>Total For VFD Project:</b>			<b>\$30,070</b>
<b>Add For New Motors:</b>			<b>\$7,750</b>

**Town Of Concord      Beede Center**  
**ECM #4 - Pool Pumps - Variable Frequency Drives - Annual Energy Savings Analysis**

**Premium Efficiency Motor Installations**

Pump Motor #	Pump Service		Existing Motor Data			
			HP	Frame	Efficiency	RPM
1	Dive Pool	Main	20	256JP	88.5%	1750
2	Lap Pool	Main	25	284JP	90.9%	1755
3	Therapy	Main	15	254JP	87.5%	1760
4	Children's	Main	7 1/2	213/5 JM	87.5%	1760
5	Therapy	Jets	5	184JM	84.0%	1740
6	Children's	Waterfall	7 1/2	213/5 JM	87.5%	1760

<b>Speed Increase Factor</b>
1.026

Pool Pump Motor	Motor HP	Estimated Load Factor	Annual Run Hours	Existing Motor			Without Variable Frequency Drives Premium Efficiency Motor				With Variable Frequency Drives Premium Efficiency Motor			
				Motor Efficiency	Motor Input kW	Annual kWh	Motor Efficiency	Motor Input kW	Annual kWh	Annual kWh Saved	Motor Efficiency	Motor Input kW	Annual kWh	Annual kWh Saved
1	20	80%	8,760	88.5%	13.5	118,146	93.0%	13.2	115,345	2,801	93.0%	12.8	112,429	5,717
2	25	80%	8,760	90.9%	16.4	143,783	93.0%	16.5	144,182	-398	93.0%	16.0	140,537	3,247
3	15	80%	8,760	87.5%	10.2	89,622	92.4%	9.9	87,071	2,552	92.4%	9.7	84,870	4,753
4	7 1/2	80%	8,760	87.5%	5.1	44,811	91.0%	5.0	44,205	606	91.0%	4.9	43,088	1,724
<b>Totals</b>						<b>396,363</b>			<b>390,803</b>	<b>5,560</b>				<b>15,440</b>

**Town Of Concord      Beede Center**  
**ECM #4 - Pool Pumps - Variable Frequency Drives - Annual Energy Savings Analysis**

**Variable Frequency Drive Installations - Pool Water Flow Rates Base Data**

Pool	Code Required Turnover Hours	NSPF Turnover Hours	Existing Pump Design GPM	Pool Water Content Gallons	Existing Turnover Minutes	Existing Turnover Hours	Potential Water Flow Rate Reductions		Potential Minimum Pump Speed (Theoretical)		Proposed Minimum Pump Speed (With Safety Factor)	
							Code	NSPF	Code	NSPF	Code	NSPF
Dive Pool	8	6	910	123,750	136	2.3	72%	62%	28%	38%	40%	50%
Lap Pool	8	6	1,050	297,369	283	4.7	41%	21%	59%	79%	60%	80%
Therapy	1/2	1/2	515	15,500	30	0.5	0%	0%	100%	100%	100%	100%
Children's	4	3	295	7,000	24	0.4	90%	87%	10%	13%	30%	40%

Pools Annual Occupied Hours	4,975
Pools Annual Unoccupied Hours	3,785

VFD Losses	VFD Exponent
3%	2.5

Pool Pump Motor	Pool	Motor HP	Motor Input kW	Motor Input kW
			Existing Motor	New Premium
1	Dive	20	13.5	12.8
2	Lap	25	16.4	16.0
4	Children's	7.5	10.2	4.9

**Annual Energy Savings With Variable Frequency Drives (With Installation Of New Premium Efficiency Motors)**

Pool Pump Motor	Estimated Savings With VFD Control												Annual kWh Saved	
	Load Point #1			Load Point #2			Load Point #3			Load Point #4				
	Percent Speed	Annual Hours	Motor Input kW	Percent Speed	Annual Hours 70%	Motor Input kW	Percent Speed	Annual Hours 20%	Motor Input kW	Percent Speed	Annual Hours 10%	Motor Input kW		
1	40%	3,785	1.3	50%	3,482	2.3	75%	995	6.4	100%	497	13.2	91,938	
2	60%	3,785	4.6	80%	3,482	9.5	90%	995	12.7	100%	497	16.5	72,484	
4	30%	3,785	0.2	40%	3,482	0.5	60%	995	1.4	100%	497	5.1	38,149	
	Unoccupied Hours			Occupied Hours			Occupied Hours			Occupied Hours				
													Total	202,570

**Town Of Concord      Beede Center**  
**ECM #4 - Pool Pumps - Variable Frequency Drives - Annual Energy Savings Analysis**

**Annual Energy Savings With Variable Frequency Drives (With Existing Motors)**

Pool Pump Motor	Estimated Savings With VFD Control												Annual kWh Saved
	Load Point #1			Load Point #2			Load Point #3			Load Point #4			
	Percent Speed	Annual Hours	Motor Input kW	Percent Speed	Annual Hours 70%	Motor Input kW	Percent Speed	Annual Hours 20%	Motor Input kW	Percent Speed	Annual Hours 10%	Motor Input kW	
	1	40%	3,785	1.4	50%	3,482	2.5	75%	995	6.8	100%	497	
2	60%	3,785	4.7	80%	3,482	9.7	90%	995	13.0	100%	497	16.9	
4	30%	3,785	0.5	40%	3,482	1.1	60%	995	2.9	100%	497	10.5	
	Unoccupied Hours			Occupied Hours			Occupied Hours			Occupied Hours			
												Total	192,395

**Town Of Concord                      Beede Center**  
**ECM #5 - Pool Covers - Annual Energy Savings Analysis**

Pool Dimensions				<b>Note:</b> Children's Pool is excluded from pool cover project
Pool	Length (Feet)	Width (Feet)	Area (Sq. Ft.)	
Dive	33.0	40.0	1,320	
Lap	75.0	82.0	6,152	
Therapy	30.0	19.8	593	
Children's	30.0	31.5	945	
<b>Total Area:</b>			<b>9,009</b>	

Pool Water Heating Savings Due To Reduced Evaporation	Existing Annual MMBtu	Proposed Annual MMBtu	Annual MMBtu Saved	Pool Water Heater Efficiency	Annual Therms Saved
	2,699	1,943	756	85%	8,896

Annual Pool Enclosure Dehumidification Energy Savings	
Annual Water Evaporation Reduction - kGal	84
Annual Water Evaporation Reduction - Pounds Moisture	701,727
Water Heat Content - Btu/Lb	1,047
Annual Pool Enclosure Humidity Load Reduction - MMBtu	735
Estimated Average Dectron Unit Coefficient of Performance (COP)	3.5
Dectron Unit - Reduction In Annual Power Usage (MMBtu)	210
Dectron Unit - Reduction In Annual Power Usage (kWh)	61,505

**ECM Opinion Of Probable Cost**

Alta Systems Quote - Turnkey Total Cost	\$ 107,178
Pool Square Footage Covered In Quote	9,023
Average Cost Per Square Foot Covered	\$ 12
Exclude Children's Pool - Square Feet	945
Total Square Footage In Project	8,078
Estimated Revised Cost	\$ 95,953
Contingency - Percent	15%
<b>Project Total</b>	<b>\$ 110,346</b>

**Town Of Concord                      Beede Center**  
**ECM #5 - Pool Covers - ECM Summary**

<b>Dectron Unit Annual kWh Saved</b>	<b>Cost Per kWh</b>	<b>Pool Makeup Water Heating Annual Therms Saved</b>	<b>Cost Per Therm</b>	<b>Annual Energy Cost Savings</b>	<b>Opinion Of Probable Project Construction Cost</b>	<b>Simple Payback</b>
61,505	\$0.09	8,896	\$1.24	\$ 16,291	\$ 110,346	6.8

<b>Pool Makeup Water Annual kGal Saved</b>	<b>Water Cost Per kGal</b>	<b>Annual Water Cost Savings</b>	<b>Total Energy And Water Cost Savings</b>	<b>Simple Payback With Water Cost Savings</b>
84	\$16.80	\$ 1,416	\$ 17,707	6.2